Individual Differences in the Processing of Punishment and Reward Cues: An Application to Road Safety Messages

Sherrie-Anne Kaye

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Faculty of Health

Queensland University of Technology

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Reinforcement Sensitivity Theory, message processing, message acceptance, road safety, anti-speeding messages, young drivers, lexical decision task, Event-Related Potentials.

Abstract

Gray and McNaughton's (2000) revised Reinforcement Sensitivity Theory (RST) proposes three underlying neural motivational systems: the Behavioural Approach System (BAS; activated by reward cues), the Fight-Flight-Freeze System (FFFS; activated by punishment cues), and the Behavioural Inhibition System (BIS; a conflict resolution system). Based within the revised RST framework, this research program examined the extent to which individual differences in the BAS and the FFFS influenced persuasive processing and outcomes. Specifically, young drivers' (aged 17-25 years) processing and subsequent acceptance of gain-framed and loss-framed anti-speeding messages which also differed in threat type (i.e., physical versus social threats) was examined. The role of the BIS was also assessed by exposing participants to conflicting cues via a social loss-framed message (depicting the negative social consequences associated with speeding behaviour) and a motor vehicle message (promoting a high performance vehicle akin to a vehicle manufacturer's commercial advertisement). Six studies examined the potential effects of individual differences in sensitivities of the revised RST systems on message processing and message acceptance.

Studies 1a (*n* = 51), 1b (*n* = 21), and 1c (*n* = 17) utilised both quantitative and qualitative research methods to pilot and refine the text-based road safety messages as well as the motor vehicle message that would be used in Study 2 to activate the RST traits. Study 2 (*n* = 133) used a lexical decision task to examine differences in message processing as a function of the BAS, the FFFS, and the BIS traits. A range of self-report and objective measures assessed the RST traits, while self-report measures assessed message acceptance (message effectiveness, attitudes, behavioural intentions, as well as message compliance, the latter construct which was reported one week after viewing the message). The results revealed no significant effects of BAS/ FFFS traits on message processing. However, there

were significant moderate positive relationships observed between the RST traits and message acceptance according to message frame. In particular, greater BAS sensitivity predicted greater effectiveness ratings and more favourable attitudes towards both the physical and social gain-framed messages. Additionally, there were some significant effects of BIS (i.e., avoidant/ inhibited behavioural responses) on processing the social loss-framed message and motor vehicle message (mixed message condition). While these findings supported the theoretical changes to the BIS/ FFFS, they also revealed that more anxious individuals (greater BIS) processed the road safety message to a lesser degree than their counterparts when it was presented in conjunction with the motor vehicle message.

Study 3 built upon Study 2 by utilising electroencephalography (EEG) to examine individuals' processing of visual images taken from existing Australian anti-speeding advertisements, as a function of the BAS and the FFFS traits. Study 3a (n = 27) first piloted these positive and negative picture stimuli for their suitability to activate the BAS and FFFS traits, respectively. Using a computerised visual oddball paradigm task, Study 3b (n = 16) examined if individual differences in the BAS and the FFFS traits influenced pre-attention and/ or cognitive processing of these images as measured via three Event-Related Potential (ERP) components: N100, N200, and P300. Contrary to RST predictions, individuals with stronger BAS traits elicited a greater N200 response towards the negative picture stimuli suggesting greater pre-attentional processes of these negative images. No other significant effects of BAS or FFFS on picture processing were found.

Overall, this program of research provides further support for the revised RST framework, suggesting that fear and anxiety are independent emotional systems. The findings also offer some support towards the design and use of both gain-framed and loss-framed road safety messages to target individual differences in the BAS and the FFFS traits, respectively. Specifically, individuals with stronger BAS traits (who are more likely to partake in riskier

on-road behaviours) may be more persuaded by gain-framed messages rather than loss-framed messages. This finding is noteworthy given the extent to which it is the latter type of approach which has traditionally been utilised in the road safety advertising context. Creating a range of messages that differ according to frame and threat type and which align with personality types may increase message persuasiveness and ultimately, reduce risk taking behaviour. Additionally, the findings highlight the potential negative influence of promotional motor vehicle advertisements that depict unsafe driving behaviour on accepting road safety messages, specifically for more anxious individuals (i.e., stronger BIS traits). This program of research has significant theoretical and methodological implications for research into the revised RST and the utility of assessing processing effects via objective measures. This research also has important practical implications for understanding the persuasive process and outcomes of road safety advertising.

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List of Abbreviations

ASB	Advertising Standards Bureau
BAS	Behavioural Approach System
BIS	Behavioural Inhibition System
BITRE	Bureau of Infrastructure, Transport and Regional Economics
CARROT	Card Arranging Reward Responsivity Objective Task
EEG	Electroencephalography
ELM	Elaboration Likelihood Model
EOG	Electrooculogram
ERP	Event-Related Potential
fMRI	functional Magnetic Resonance Imaging
FFS	Fight-Flight System
FFFS	Fight-Flight-Freeze System
IAPS	International Affective Picture System
LDT	Lexical decision task
LPP	Late positive potential
RST	Reinforcement Sensitivity Theory
RT	Reaction Time
SCR	Skin Conductance Response
TAC	Transport Accident Commission
TPE	Third-person effect
WHO	World Health Organization

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Name: Sherrie-Anne Kaye

QUT Verified Signature

Signed:

Date: 16/12/14

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Chapter 1. Introduction and Overview

1.1 Chapter overview

This chapter provides an overview of the program of research. A brief background to the topic area is first presented, followed by the overall research aims. The significance of this dissertation is then discussed in the context of the revised Reinforcement Sensitivity Theory (RST) and understanding the persuasive process and outcomes of road safety advertising. The chapter concludes by presenting an overview of the structure of the dissertation.

1.2 Context of research

Gray and McNaughton's (2000) revised RST extended upon Gray's (e.g., 1970, 1982) original RST. The revised RST proposes that three neural-based motivational systems underlie behaviour: the Behavioural Approach System (BAS; sensitive to rewards), the Fight-Flight-Freeze System (FFFS; sensitive to punishments), and the Behavioural Inhibition System (BIS; activated on presentation of conflict cues, such as simultaneous reward and punishment cues associated with the same behaviour; see Figure 1.1 for a schematic overview of the revised RST traits and their relation to this research program). While Gray and McNaughton's revisions were incorporated into the theory over 13 years ago, research in the health communication field that examines the influence of the RST traits on the relative effectiveness of message framing manipulations involving reward and punishments (i.e., gain-framed and loss-framed messages) continues to be based upon the original conceptualisation of the BAS and the BIS. While minimal changes were made to the BAS, the BIS and the FFFS were substantially revised by Gray and McNaughton. It is timely to examine the revised RST predictions regarding the influence of the BAS, FFFS, and BIS in a persuasive health communication context. Further, and to the best of the author's knowledge, no published research has assessed the importance of the BIS on message processing.

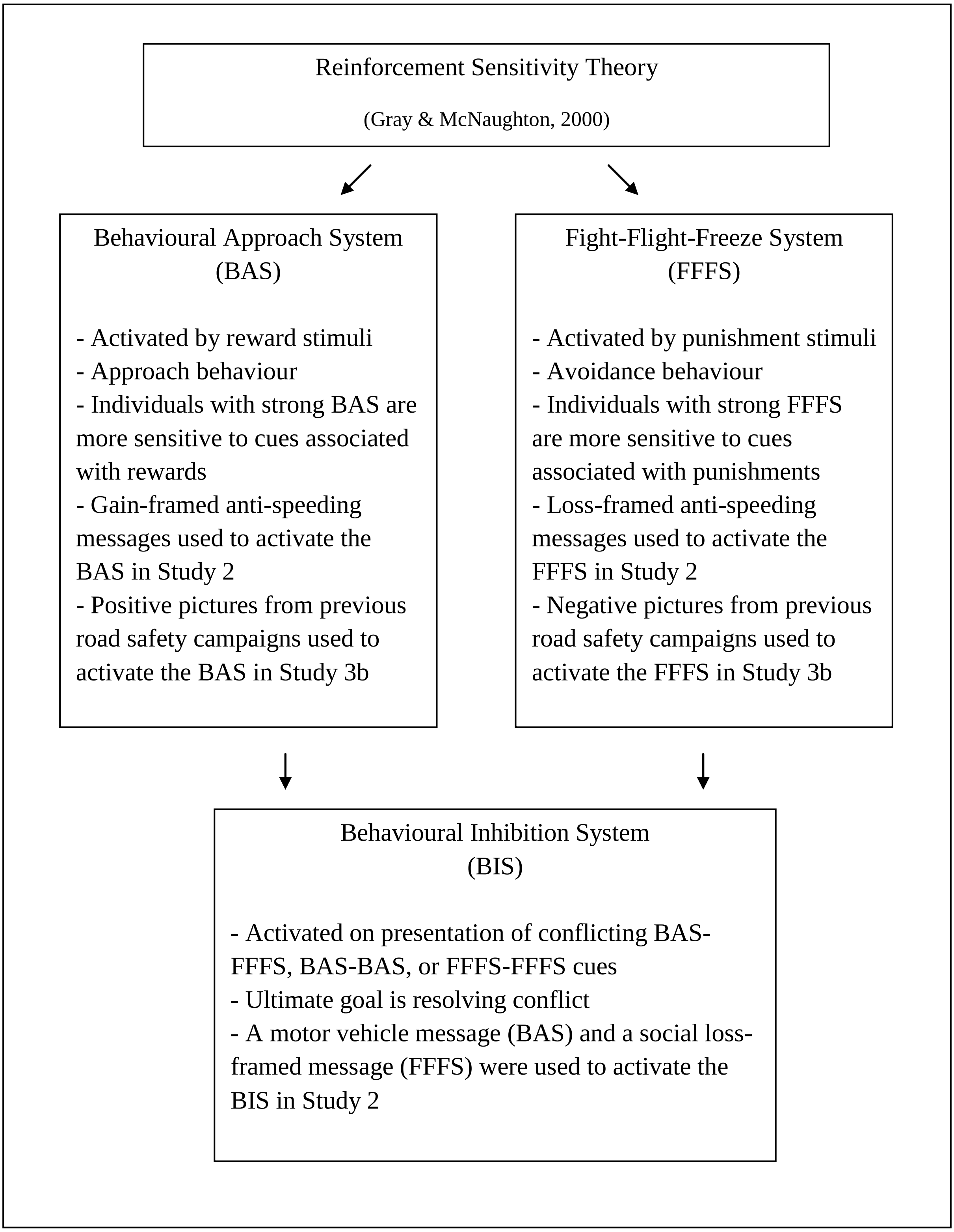

Figure 1.1. Schematic overview of the revised RST traits and their activation in this research program.[1]

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[1] Chapter 2 presents an in-depth discussion of the revised RST.

Road safety messages are one health communication strategy designed to reduce reckless driving behaviour, such as speeding behaviour. Road safety messages typically use threat-based appeals to encourage drivers to abide by the speed limits (i.e., appeals which incorporate negative emotions and/ or highlight the costs associated with risky driving behaviour). More recently, however, research has reported that positive road safety appeals (i.e., appeals which incorporate more positive emotions and/ or demonstrate the benefits/ rewards associated with engaging in the correct/ safer behaviour) may be more effective for some groups of drivers, particularly young male road users (e.g., Lewis, Watson, & White, 2009). RST may offer additional insight into other individual differences that may be important in the acceptance of such different message types.

Exposure to mixed message cues from alternative media campaigns, such as promotional motor vehicle advertisements, may potentially negatively influence the persuasiveness of opposing road safety messages. While road safety advertisements are designed to encourage safer/ legal on-road behaviours, motor vehicle advertisements are developed to promote and sell vehicles. Despite the implementation of the Advertising for Motor Vehicles Voluntary Code of Practice, the Advertising Standards Bureau (ASB) continues to receive consumer complaints about the unsafe driving behaviours that are portrayed in some motor vehicle advertisements (ASB, 2014). Limited empirical research has explored if exposure to motor vehicle advertisements impacts upon the persuasiveness of road safety messages.

The current research was conducted in Australia, where young drivers are overrepresented in road crashes and, despite acknowledging the risks, speeding remains one of the most pervasive and commonly engaged in driving violation, suggesting a degree of social acceptance with the behaviour (e.g., Bureau of Infrastructure, Transport and Regional Economics [BITRE], 2013; Fleiter & Watson, 2006). It is therefore important to design effective road safety messages specifically targeting these high risk drivers. Designing messages that align with high risk personality dispositions may be one approach to target young drivers. Previous research has reported that individuals with stronger BAS traits are more likely to partake in risky behaviour, such as speeding behaviour (e.g., Harbeck & Glendon, 2013). According to RST, those with stronger BAS traits are more likely to approach reward stimuli, and may therefore by more sensitive to gain-framed messages rather than threat-based road safety appeals. Given that research has yet to examine if individual differences in young drivers' reward and punishment traits influence road safety message processing and subsequent message acceptance, further research is required in this area.

1.3 Overall research aims

Two overarching aims underpinned this research. The first aim was to examine the extent to which individual differences, as conceptualised by Gray and McNaughton's (2000) revised BAS, FFFS, and BIS traits, influenced young drivers' processing and subsequent acceptance of text-based gain-framed and loss-framed anti-speeding road safety messages alone, and in conjunction with an advertisement for a high performance vehicle (Studies 1 and 2). The second aim was to assess if individual differences in the BAS and the FFFS traits influenced young drivers' processing of positive and negative still images used in previous televised Australian anti-speeding advertisements (Studies 3a and 3b).

1.4 Original contribution to knowledge

This program of research has significant theoretical, practical, and methodological implications for research into the revised RST and understanding the persuasive process and outcomes of road safety advertising. Specifically, this research contributes to the literature by examining Gray and McNaughton's (2000) revised RST traits in conjunction with message framing to explore the relative effectiveness of road safety messages designed to target young road users. Given that most of the previous research has used self-report measures to assess the influence of the original RST traits on message processing, two objective measures (i.e., lexical decision task [LDT] and Event-Related Potentials [ERP]) were used to assess message processing.

1.4.1 Gray and McNaughton's (2000) revised Reinforcement Sensitivity Theory

With one exception (Kaye, White, & Lewis, 2013),[2] published research in the health communication field that has examined the relative effectiveness of different message frames (i.e., gain-framed and loss-framed messages) according to different RST traits has relied upon the original definitions of Gray's (1970, 1982) BAS and BIS[3] traits (e.g., Hevey & Dolan, 2013; Mann, Sherman, & Updegraff, 2004). Further, while Gray's original BIS was designed to reflect behavioural inhibition, previous health communication studies have interpreted the BIS to reflect behavioural avoidance (e.g., Hevey & Dolan, 2013; Mann et al., 2004; Van 't Riet, Ruiter, & De Vries, 2011). Since behavioural inhibition and behaviour avoidance are two separate constructs, further research is required to distinguish between these inhibition and avoidance systems to more accurately assess the role of individual differences in processing loss-framed messages.

Applying the revised RST, this program of research assessed objectively if individual differences in BAS and FFFS sensitivities predicted the degree of message processing. The studies also examined RST trait effects on message acceptance. Further, to assess the BIS, a goal conflict condition was devised in which participants were exposed to mixed message cues (i.e., a road safety message that highlighted the negative consequences associated with speeding behaviour (FFFS) and a motor vehicle message that was designed to highlight the positive aspects of a high performance vehicle (BAS)). Thus, the current program of research

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[2] This publication is from the candidate's earlier Honours research.

[3] Gray's original BIS trait is conceptually similar to Gray and McNaughton's revised FFFS trait.

broadens the scope of previous persuasion studies by examining all three motivational systems that underpin the revised RST: the BAS, the FFFS, and the BIS.

1.4.2 Message processing

The current research also uniquely contributes to the literature by incorporating two objective measures (i.e., LDT and ERPs) to assess message processing. Previous RST and message framing studies have tended to rely upon self-report measures to assess cognitive processing. However, message processing is likely to occur in the unconscious (e.g., Kihlstrom, 1987) and may therefore not be adequately captured by measures of self-report. Using a LDT, the current program of research was able to more objectively assess individual differences in processing of semantic information within gain-framed and loss-framed road safety messages. Further, using ERPs, the research program examined if individual differences in reward and punishment sensitivities influenced variations in attention and cognitive processing of still images that had previously been presented in televised anti-speeding campaigns for the Transport Accident Commission (TAC) of Victoria, Australia.

1.4.3 Young drivers

Young drivers (17-25 years of age) are over represented in road trauma. For instance, young drivers accounted for 22% (i.e., 286 fatalities) of all driver fatalities on Australian roads in 2012 (BITRE, 2013; see chapter 4). Thus, countermeasures, such as road safety messages, are invested in by Governments to help reduce and prevent such trauma together with other strategies, including enforcement. Previous empirical evidence has reported that drivers with higher sensation seeking and reward sensitivity traits are particularly vulnerable to speeding behaviour (e.g., Scott-Parker, Watson, King, & Hyde, 2012, 2013; Ulleberg & Rundmo, 2003) and thus, it is of value to identify these characteristics and target these individuals through message design. Young males, in particular, also tend to have higher sensation seeking dispositions than other demographic groups (e.g., Dahlen & White, 2006).

By identifying how these subgroups are likely to process and respond to particular types of road safety messages, based on their personality dispositions, it may be more possible to devise messages by aligning the message content and frame with the processing styles of high risk individuals or groups of individuals.

1.4.4 Physiological measures in advertising research

To the best of the author's knowledge, this research is the first to incorporate ERPs to assess message processing effects in relation to road safety advertising messages. While brain imaging measures are commonly applied to evaluate product and brand marketing campaigns (e.g., vehicles and food products; Astolfi et al., 2008a), using physiological measures to assess the processing of health communication messages is currently an emerging research field. This program of research demonstrates the importance of using supplementary neural measures, such as ERPs, to enhance our understanding of how young drivers' process road safety messages and, thus, to subsequently aid the design of more effective messages to target higher risk individuals. To assess message processing, a computerised visual oddball paradigm was devised that utilised positive and negative still images from previous televised road safety campaigns[4] to examine if trait differences in the BAS and the FFFS influenced pre-attentional and/ or cognitive processing of these images (measured using three ERP components: N100, N200, and P300).

1.5 Thesis structure

The literature review spans four chapters. Chapter 2 reviews Gray and McNaughton's revised RST and emphasises the relevance of examining the BAS, FFFS, and BIS. Chapter 3 reviews the literature on message framing effects and message acceptance and highlights a potential influence of BAS and FFFS traits on these relationships. It also discusses how

[4] Neutral images that were sourced from the internet were also included in the oddball task. Chapter 8, section 8.6.3.1, provides more information on the oddball paradigm that was used.

conflicting cues such as those presented in promotional motor vehicle advertisements, may also have an influence upon an individuals' acceptance of road safety messages. For instance, given that road safety messages exist in a complex media environment in which they compete with promotional motor vehicle advertisements, that may depict unsafe driving behaviour, it is important to understand the influence that these promotional vehicle advertisements have on the persuasiveness of road safety messages. Chapter 4 discusses the factors which contribute to young drivers engaging in unsafe driving behaviour relative to older, more experienced road users. Chapter 4 highlights the importance of creating effective countermeasures, such as road safety messages, to target these high risk young drivers. Next, chapter 5 reviews the literature on cognitive processing and focuses specifically on the use of ERPs in assessing individual differences in the processing of text-based messages and still picture images.

Chapter 6 presents the first three studies (i.e., Studies 1a, b, and c). These three studies were designed to pilot and refine the message stimuli (i.e., four road safety messages and one motor vehicle message) for their suitability to activate the BAS, the FFFS, and the BIS. Chapter 7 presents the main study of this research program (i.e., Study 2) that was designed to assess if individual differences in the BAS and the FFFS traits influenced young drivers' processing and subsequent acceptance of gain-framed and loss-framed road safety messages. Chapter 7 also explores the influence of the BIS in a conflicting message condition by exposing participants to both a road safety message that emphasised the negative consequences of speeding behaviour (designed to activate the FFFS) and a high performance motor vehicle message (designed to activate the BAS) to further evaluate processing biases.

Chapter 8 comprises the final two studies (i.e., Study 3a and 3b) that extend upon Study 2 by the use of ERPs to more comprehensively assess message processing. Study 3a was designed to pilot the positive and negative picture stimuli for their suitability to activate the BAS and the FFFS in Study 3b. Study 3b examined if individual differences in the BAS and the FFFS traits influenced individuals' processing (as measured by ERPs) of these still images. Figure 1.2 provides an overview of all the studies in this research program. Finally, a general discussion of the overall findings of this research program and final conclusions are presented in chapter 9. This final chapter also discusses some of the strengths and limitations of the research program and highlights the theoretical, methodological, and practical implications of the research findings to the RST and the health communication field.

1.6 Chapter summary

This chapter provided an overview of the current program of research. The rationale of examining the contribution of the revised RST traits on message processing and subsequent message acceptance in a sample of young drivers was discussed. The chapter then presented the two overarching research aims that underpinned the research program, before discussing how this research program provides an original contribution to knowledge in the fields of RST and health communication. The chapter concluded by presenting the structure of the thesis in terms of the order of the research studies.

Study 1 (Chapter 6)

Purpose: To pilot test, refine, and finalise the road safety messages and motor vehicle message for their suitability for Study 2.

	Study 1a	***Study 1b***	***Study 1c***
Participants:	*n* = 51	*n* = 21	*n* = 17
Design:	Mixed design, Quantitative	Between-groups, Quantitative	Qualitative
Measure(s):	Self-report ratings	Self-report ratings	Group discussions (i.e., interviews & focus groups)
Analysis:	*t*-tests; descriptives	*t*-tests; descriptives	Thematic analysis

↓

Study 2 (Chapter 7)

Purpose: To examine to what extent individual differences, as conceptualised by Gray and McNaughton's (2000) revised BAS, FFFS, and BIS traits, influenced young drivers' processing and acceptance of text-based gain- and loss-framed anti-speeding messages and a motor vehicle message.

Participants:	*n* = 133
Design:	Between-groups, Quantitative design
Measure(s):	Self-report measures: personality, message acceptance, perceptual biases, and risk taking behaviour Objective measures: LDT (processing), Q-Task (punishment), and the Card Arranging Reward Responsivity Objective Test (CARROT; reward)
Analyses:	Main: Bivariate correlations; Mediations; Between-groups ANOVAs Supplement: *t*-tests

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Study 3 (Chapter 8)

Purpose: To examine if individual differences in BAS and FFFS traits influence young drivers' processing of still images taken from previous televised Australian anti-speeding advertisements.

	Study 3a (pilot)	***Study 3b (main)***
Participants:	*n* = 27	*n* = 16
Design:	Within-groups	Within-groups
Measure(s):	Self-report ratings	1. Self-report personality measures 2. Oddball paradigm task (i.e., assess ERPs)
Analysis:	*t*-tests; descriptives	1. Bivariate correlations 2. Repeated measures ANOVAs

Figure 1.2. Overview of studies in this research program.

Chapter 2. Gray and McNaughton's (2000) revised Reinforcement Sensitivity Theory

2.1 Chapter overview

This chapter reviews the literature on Gray and McNaughton's (2000) revised Reinforcement Sensitivity Theory (RST). The background to the development of the revisions to the RST is initially presented, followed by a critical review of the three motivational systems that underpin this theory: the Behavioural Approach System (BAS), the Fight-Flight-Freeze System (FFFS) and the Behavioural Inhibition System (BIS). This chapter emphasises the relevance of the revised RST traits to information processing and behaviour and the need to further examine the substantially revised FFFS and BIS constructs. Next, this chapter provides an overview of the proposed underlying neural structures of the revised RST systems and concludes by discussing alternative predictions of the revised RST, known as the separable and joint subsystem hypotheses.

2.2 Biological models of personality

Gray and McNaughton's (2000) revised Reinforcement Sensitivity Theory (RST) extends upon Gray's (1970, 1972, 1975, 1976, 1982, 1987) original RST, a biological theory of personality/ motivation. Derived from animal learning studies, the RST posits that the nervous system regulates behaviour. Gray's theory was developed as an alternative approach to Eysenck's (1967) biological arousal model of personality. Eysenck (1967) originally proposed that personality could be classified into three major dimensions: Extraversion-Introversion, Neuroticism-Stability, and Psychoticism-Conformity, with each dimension consisting of underlying related traits. Of Eysenck's three major dimensions, Extraversion-Introversion and Neuroticism-Stability have received the greatest research attention (Eysenck & Eysenck, 1985; Matthews & Gilliland, 1999).

2.2.1 Eysenck's Biological Arousal Model of Personality

Eysenck (1967) proposed that two neural arousal systems, the ascending reticular activating system and the limbic system, accounted for individual differences in Extraversion and Neuroticism, respectively. According to Eysenck (1967), the ascending reticular activating system was more active in introverts than in extraverts. Specifically, he proposed that introverts generally have higher levels of cortical arousal compared to extraverts and therefore, are less likely to seek out further stimulation from the outside environment. In turn, extraverts have lower levels of cortical arousal than introverts due to their underactive ascending reticular activating system and, thus, are more likely to seek out further stimulation from the outside environment. According to Eysenck's (1967) model, when introverts and extraverts are exposed to the same unconditioned stimulus, introverts should be easier to condition than extraverts due to their higher levels of cortical arousal. In relation to Neuroticism, the limbic system was proposed as being responsible for emotional responses in stressful situations. Specifically, individuals high in neuroticism are typically more aroused and therefore, more likely to become distressed in these situations. In contrast, individuals low in neuroticism are typically less aroused and therefore, less likely to become distressed when exposed to stressful situations.

2.2.2 Gray's original Reinforcement Sensitivity Theory

Gray (1970, 1982) proposed two major changes to Eysenck's biological arousal model of personality. First, Gray suggested that the ascending reticular activating system works with the hippocampus, the orbital frontal cortex, and the mesial septal area to account for individual differences between introverts and extraverts. As previously stated, Eysenck's (1967) model postulated that it was only the ascending reticular activating system that accounted for individual differences on the Extraversion-Introversion dimension. Second, Gray proposed that Eysenck's Extraversion and Neuroticism orthogonal axes should be rotated by 45 degrees to more broadly represent reward sensitivity (i.e., Behavioural Approach System; BAS) and punishment sensitivity (i.e., Behavioural Inhibition System; BIS). Gray considered Eysenck's third factor, Psychoticism, to align with the Fight-Flight System (FFS).

Gray's (1970, 1982) RST predicted that individuals differ as to whether they are more sensitive to cues of reward (i.e., strong BAS) or more sensitive to cues of punishment (i.e., strong BIS). Specifically, individuals with a strong BAS were sensitive towards conditioned reward stimuli, while individuals with a strong BIS were sensitive towards conditioned punishment stimuli. Gray proposed that these reward and punishment systems were independent of each other and, thus, an individual's BAS sensitivity and subsequent approach behaviour was only activated by the presence of reward stimuli (regardless of their original BIS sensitivity or the presence of punishment cues). In turn, an individual's original BIS sensitivity and subsequence behavioural inhibition was only activated by punishment stimuli (regardless of their BAS sensitivity or the presence of reward cues).[5] Finally, Gray's original FFS was activated only when individuals were exposed to unconditioned threats (e.g., painful stimuli).

2.2.3 Gray and McNaughton's revised Reinforcement Sensitivity Theory

Due to the subsequent research developments in neurophysiology, Gray and McNaughton (2000) extended upon Gray's (1970, 1982) original RST. Consequently, various changes were made to the three motivational systems. Specifically, for the revised BAS, current conceptualisations posit that activation of this system now occurs on presentation of either conditioned or unconditioned reward stimuli (Corr, 2004). In Gray's original theory, the BAS was only activated by conditioned reward stimuli. This amendment to the BAS is minor. The BIS and the FFS received the greatest revisions.

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[5] Corr (2001, 2002) later referred to this process as the separable subsystem hypothesis.

Gray’s original RST combined two emotional responses: fear and anxiety (Gray & McNaughton, 2000). However, subsequent neurological research suggested that fear and anxiety derive from two independent emotional systems (e.g., Blanchard & Blanchard, 1990; Blanchard, Griebel, & Blanchard, 2001; Blanchard, Griebel, Henrie, & Blanchard, 1997). The research by Blanchard and colleagues found that when rats were injected with psychiatric drugs, these drugs had different effects on the rats’ normal fear and anxiety responses towards a threatening stimulus (i.e., a cat) or a potentially threatening stimulus (i.e., cat odour). For instance, while panicolytic drugs were shown to reduce the rats’ fear response, these types of drugs did not affect the rats’ anxiety response. In turn, anxiolytic drugs reduced the rats’ anxiety response, but not the rats’ fear response (Blanchard et al., 1997). The differential effects of the psychiatric drugs on the rats’ fear (i.e., flight and freeze) and anxiety (i.e., risk assessment) responses suggest different underlying neural circuits. Similar findings have also been reported in humans (e.g., White & Depue, 1999). Accordingly, it was argued that while fear and anxiety likely interact with each other, they are essentially independent emotional systems (see Blanchard et al., 1997). Based on such research findings, there is now a clear distinction between fear (i.e., avoidance response) and anxiety (i.e., risk assessment/ approach with caution response) in the revised RST.

The FFS previously consisted of two responses: fight in response to unavoidable proximal threat stimuli and flight which resulted in escape to avoidable distal threat stimuli (Gray, 1987). The purpose of the FFS was to mediate these two responses to unconditioned threat stimuli. In the revised RST, the FFS is classed as an independent fear response system and consists of an additional behavioural response (i.e., Freeze; Gray & McNaughton, 2000). The revised Fight-Flight-Freeze System (FFFS) is activated by both conditioned and unconditioned aversive stimuli. The BIS which, in the original theory, was activated on presentation of punishment stimuli, in the revised RST is activated only when conflict occurs between the BAS and the FFFS (Gray & McNaughton, 2000).

Revised Behavioural Approach System. The revised BAS is activated by reward stimuli and results in approach behaviour (Gray & McNaughton, 2000). Individuals with a stronger BAS are more sensitive to cues of reward than those with weaker BAS traits. Specifically, those with a stronger BAS are more likely to approach incentive cues compared to those with a weaker BAS (Corr, 2008). The BAS can be viewed as a positive feedback system. Thus, individuals with a stronger BAS experience positive emotions, such as anticipation, pleasure and hope, when they perceive the reward stimuli to be attainable (Corr, 2008). These positive emotions then lead to a stronger desire to approach similar reward stimuli in the future. It should also be noted that the BAS is not thought to be activated on receiving the reward(s) per se; rather, activation occurs when the individual perceives the reward(s) to be achievable (Smillie, Loxton, & Avery, 2011).

Consistent with the theoretical predictions of the BAS, studies have reported that individuals with a more sensitive reward system have a stronger desire to approach reward cues (e.g., alcohol-related reward cues) than those with a weaker reward system (e.g., Franken, 2002; Kambouropoulos & Staiger, 2001, 2009). Franken (2002) examined the influence that the BAS had on responses to alcohol-related picture cues and found that individuals with a stronger BAS reported stronger intentions and desires to drink alcohol when exposed to alcohol-related cues compared to those with a weaker BAS. Further, Kambouropoulos and Staiger (2001, 2009) found that heavy drinkers[6] who were more sensitive to rewards reported more positive urges to drink compared to those with a weaker reward system. In addition to having a greater sensitivity to alcohol cues, individuals with a

[6] Heavy drinkers were defined as males who drank five or more drinks per week and females who drank four or more drinks per week over a two week period (2001) or over a four week period (2009).

stronger BAS are more likely to participate in risky driving behaviours (Castellá & Pèrez, 2004; Constantinou, Panayiotou, Konstantinou, Loutsiou-Ladd, Kapardis, 2011; Harbeck & Glendon, 2013; Scott-Parker et al., 2012, 2013). For instance, in a sample of 792 drivers, Castellá and Pèrez (2004) found that the drivers who reported higher scores on the Sensitivity to Reward component of the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ; Torrubia, Avila, Molto, & Caseras, 2001) also reported higher traffic violations. Further, Harbeck and Glendon (2013) found that young drivers who rated high on Carver and White's (1994) BAS: Reward Responsiveness self-report Scale were more likely to report driving 10km/h over the posted speed limit than individuals with lower BAS: Reward Responsiveness scores. Collectively, these studies highlight that individuals who are more sensitive to rewards may be more susceptible to engaging in risky behaviours such as, hazardous drinking and risky driving.

Revised Fight-Flight-Freeze System. The revised FFFS is proposed to be activated by punishment stimuli and results in avoidance behaviour (Gray & McNaughton, 2000). Accordingly, individuals with a strong FFFS are more sensitive to cues associated with punishment. The FFFS comprises of three behavioural responses: Fight, Flight, and Freeze. The Fight system is activated when the individual is exposed to a proximal threat and escape is unavoidable, while the Flight and Freeze systems are activated by distal threats (Gray & McNaughton, 2000). The main difference between the Flight and Freeze systems is that the Flight system is activated when escape is avoidable, whereas the Freeze system is activated when escape is unavoidable (Gray & McNaughton, 2000). While the BAS is conceptualised as a positive feedback system, the FFFS is proposed to act as a negative feedback system between fear and safety (Corr, 2008).

Only recently has research focused on examining the theoretical predictions of the revisions made to the FFFS (e.g., Clarke & Loxton, 2012; Hennegan, Loxton, & Mattar, 2013; Ignjatović & Todorovski, 2010; Ivory & Kambouropoulos, 2012; Jackson, Loxton, Harnett, Ciarrochi, & Gullo, 2014; Morton & White, 2013). Clarke and Loxton (2012) examined if psychological acceptance (i.e., an individual's acceptance of their own personal thoughts and feelings) influenced the relationship between FFFS and work engagement. Participants (*N* = 228) who worked seven or more hours per week completed four self-report questionnaires that measured personality, psychological acceptance, job demands, and work engagement. The results showed that psychological acceptance mediated the relationship between the FFFS and work engagement. Specifically, for individuals with a stronger FFFS who were in high demanding jobs, lower psychological acceptance ratings were associated with lower work engagement ratings. However, the same results were not found for individuals with a stronger BIS. Thus, these findings support the revisions made to the revised RST by suggesting that the FFFS (fear) and BIS (anxiety) are independent emotional systems.

Morton and White (2013) examined the influence that the FFFS had on driving performance. In a sample of 71 young Australian drivers, individuals who reported higher FFFS ratings demonstrated poorer hazard responses when completing a driving simulator task under stress. Specifically, the findings indicated that individuals who were more sensitive to punishment demonstrated shorter braking distances to signalled pedestrian crossings (delayed responses) than those individuals who reported lower FFFS scores. These findings are consistent with the theoretical predictions of the FFFS and suggest that under stressful conditions, the driving behaviour of those with a greater FFFS sensitivity may be negatively affected. However, Morton and White (2013) also found that, under the same conditions, higher FFFS drivers also demonstrated faster detection of signs located on the roads during the driving task (i.e., a safe driving behaviour).

While these studies provide some support for the revisions made to the FFFS, there has been an absence of research that has examined the revisions made to this system. Thus, future research is required to continue to examine this theoretical punishment/ avoidance system. More specifically, further research is required not only to examine the FFFS as a whole but also the individual FFFS responses (i.e., Flight, Fight, and Freeze responses). Although the three FFFS responses have been identified to be associated with punishment, Ignjatović and Todorovski (2010) found that while Fight showed a strong positive relationship with self-reported reckless driving behaviour (a response which would be predicted for the BAS), no significant relationship was found between the Flight or Freeze responses and reckless driving behaviour. Further, De Pascalis, Fiore, and Sparita (1996) reported no significant relationships between self-report measures of Fight and Flight as assessed by the Gray-Wilson Personality questionnaire (Wilson, Gray, & Barrett, 1990). These findings may suggest that the Flight and Freeze responses may be more closely associated with punishment and, in turn, the Fight response may be less associated with punishment and more associated with reward.

Revised Behavioural Inhibition System. The revised BIS is linked to the emotional state of anxiety. Similar to the revised FFFS, the BIS is also a negative feedback system with the ultimate goal of resolving conflict (Corr, 2011; Gray & McNaughton, 2000). The BIS is activated when conflict occurs between the BAS and the FFFS (or within either system). Upon activation of the BIS, attention is directed to the environment where an external and internal risk assessment of the situation is undertaken to determine the resulting approach or avoidance behaviour (Gray & McNaughton, 2000). Approach (i.e., the BAS response) is favoured when less threat is perceived, while avoidance (i.e., the FFFS response) is favoured when the threat is perceived to be greater than reward (Corr, 2008). However, when conflict arises between the BAS and the FFFS the decision to avoid the stimuli is generally selected over the decision to approach the stimuli (McNaughton & Corr, 2008). Namely, avoiding a potential risk is perceived to be a safer option than obtaining a potential reward. Not only does the BIS resolve conflict between competing reward and punishment (i.e., BAS-FFFS) goals, but the BIS also resolves conflict between competing reward (i.e., BAS-BAS) and punishment (i.e., FFFS-FFFS) goals (Corr, 2008). Such BAS-BAS or FFFS-FFFS conflicts may arise when an individual is exposed to multiple competing reward cues (e.g., deciding upon which new car to purchase) or multiple competing punishment cues (e.g., deciding upon which chores to complete on a work free weekend).

The majority of research assessing the BIS has relied upon the original conceptualisation of the BIS (i.e., punishment system; see Smillie, Pickering, & Jackson, 2006a). Few studies have examined the changes made to the redefined BIS (i.e., conflict resolution system). However, those studies which have examined the revised BIS have generally found that the BIS is involved in resolving goal conflict, thus supporting the revisions made to this system (e.g., Berkman, Lieberman, & Gable, 2009; Leue, Lange, & Beauducel, 2012). For instance, using 96 students, Berkman et al. (2009) designed a goal conflict task where participants were required to read a story about a tribe who enjoyed eating insects and cakes (but not fungi and meats) prior to responding to picture stimuli in a computerised reaction time (RT) task. Specifically, participants were required to indicate if the tribe would eat or not eat the food presented in the pictures. Approach-avoidance conflict was created because their responses contradicted their own perceptions of appealing (i.e., cakes and meats) and unappealing (i.e., insects and fungi) foods. Individuals with higher BIS scores demonstrated faster responses to the conflicting approach-avoidance cues. However, it could be argued that they should demonstrate slower RTs to the conflicting cues because both approach and avoidance behaviours are inhibited while the decision to approach or avoid the stimuli is processed.

Leue et al. (2012) used a Go/ No-Go objective task to examine neural activity (as assessed by Event-Related Potentials (ERPs), specifically the N200 mean amplitude) in response to conflicting cues, as a function of the BIS trait.[7] In support of the revised BIS, No-Go trials (requiring behavioural inhibition) resulted in a more pronounced N200 over the frontal cortex (measured at three electrode sites: F3, Fz, and F4) of individuals who reported higher BIS scores on a German version of the BIS/ BAS Scales than individuals who reported lower BIS scores. These findings indicated that individuals with stronger BIS traits showed greater inhibition towards the conflicting No-Go trials, than individuals with a weaker BIS. In conclusion, while the findings of Berkman et al. (2009) and Leue et al. (2012) provide some support for the redefined BIS, future research is still needed to assess the redefined BIS in respect to other outcomes.

2.3 Underlying neural structures

The following section provides a brief overview of the underlying neural structures of the BAS, the FFFS, and the BIS. Whilst it is beyond the scope of the current program of research to examine brain structures, it is important to introduce the neural structures in this literature review to provide a more comprehensive overview of the revised RST.

2.3.1 Behavioural Approach System

The brain structures that are associated with the dopaminergic systems have been found to underlie the BAS response (Depue & Collins, 1999; Pickering & Gray, 1999). Activation of the BAS occurs when the neurotransmitter dopamine flows from the ventral tegmental area to the prefrontal cortex via the dorsal and ventral striatum (Depue & Collins, 1999; Pickering & Gray, 1999). Previous functional Magnetic Resonance Imaging (fMRI)

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[7] Go/ No-Go tasks are used to assess behavioural inhibition (see Simmonds, Pekar, & Mostofsky, 2008). The task involves participants first responding to a pre-selected ‘Go’ stimulus in the Go trials. On completion of the Go trials, participants complete the No-Go trials. For the No-Go trials, participants are required to avoid responding to the previous ‘Go’ stimulus. This task, therefore, creates conflict between the Go (respond) and No-Go (avoid) trials and thus, assesses behavioural inhibition. Chapter’s 5 (section 5.4) and 8 (section 8.2.1) provide a discussion on ERPs.

studies have provided mixed support for the influence that these neural systems have on reward processing (e.g., Barrós-Loscertales et al., 2010; Simon et al., 2010). For instance, Simon et al. (2010) found that on presentation of a monetary incentive (i.e., 1 euro), individuals who reported a stronger BAS (as measured by a German version of Carver and White's BAS Scales) showed greater activation of the ventral striatum and mesial orbitofrontal areas. Barrós-Loscertales et al. (2010) found that on presentation of positive picture stimuli, individuals who reported a stronger BAS (as measured by the Sensitivity to Reward Scale of the SPSRQ; Torrubia et al. 2001) demonstrated greater activation of the left-lateral and mesial prefrontal cortex and right occipital cortex, not the ventral striatum as found in Simon and colleagues' research. Differences in the findings between Simon et al. (2010) and Barrós-Loscertales et al. (2010) studies may be due to differences in the self-report measures used (i.e., BAS Scales vs. Sensitivity to Reward Scale), reward stimuli (i.e., receiving 1 Euro vs. viewing picture stimuli), or participants (i.e., Simon et al. 2010 included both male and female participants, while Barrós-Loscertales et al. 2010 study only consisted of males). Thus, further research is required to continue to explore the underlying neural functions of the BAS.

2.3.2 Fight-Flight-Freeze System

Several brain structures are proposed to be involved in the FFFS, including the periaqueductal gray, the mesial hypothalamus, the amygdala, and the anterior cingulate cortex (Gray & McNaughton, 2000). The periaqueductal gray is activated by immediate threat that results in undirected escape (i.e., fight or flight) behaviour (Gray & McNaughton, 2000). The mesial hypothalamus and the amygdala govern escape and avoidance behaviour, respectively (Gray & McNaughton, 2000). Finally, the anterior cingulate is activated upon detection of threat and results in active avoidance behaviour (Gray & McNaughton, 2000).

Currently, there has been limited published research that has examined the relationship between the revised FFFS and these proposed neural structures.

2.3.3 Behavioural Inhibition System

While similar brain structures are proposed to be activated by both the FFFS and the BIS (e.g., the amygdala and the periaqueductal gray), the septo-hippocampal system is believed to be the main neural structure that underlies the BIS response (Gray & McNaughton, 2000). As with the underlying neural structures of the BAS, there also has been mixed support for the underlying neural structures of the BIS (Cherbuin et al., 2008; Fuentes et al., 2012; Hahn et al., 2010). For instance, Cherbuin et al. (2008) collected the brain scans of 430 participants aged 44 to 48 years to examine the relationship between their hippocampal volume and self-reported BIS ratings (as measured by Carver & White's BIS Scale). Those with higher BIS ratings also had a larger hippocampal volume. Further, in support of the underlying neural systems of the BIS, Hahn et al. (2010) found a strong significant positive relationship between self-reported BIS scores (as measured by the German version of the Sensitivity to Punishment Scale) and amygdala-hippocampus connectivity when participants anticipated a strong loss on a monetary incentive delay task. In contrast, Fuentes et al. (2012) reported no significant associations between self-reported BIS scores (as measured by Carver & White's BIS Scale) and hippocampus activation in 114 male participants and thus, did not support the proposed underlying neural systems of the BIS. These findings highlight the need to further examine the neural structures, specifically the septo-hippocampal system, responsible for the revised BIS response.

2.3.4 Two-dimensional model

McNaughton and Corr (2004) extended upon Gray and McNaughton's (2000) description of the neural constructs that underlie the FFFS: Fear response and BIS: Anxiety response. They proposed a two-dimensional model in which fear and anxiety are believed to be activated at both the higher (i.e., prefrontal cortex) and lower (i.e., periaqueductal gray) levels of the neural structures. Activation of these neural area(s) depends upon an individual's actual behaviour in response to a threatening stimulus (i.e., avoid or approach) and the level of perceived fear towards this stimulus (i.e., high or low level; McNaughton & Corr, 2004). Consequently, the two-dimensional model consists of defensive direction (FFFS: Fear vs. BIS: Anxiety) and defensive distance (FFFS: Fear and BIS: Anxiety).

Defensive direction. Defensive direction refers to an individual's response to a potential threat (McNaughton & Corr, 2004). Specifically, once exposed to a potential threat the individual can either avoid the threatening stimulus (i.e., FFFS: Fear response) or approach the stimulus with caution (i.e., BIS: Anxiety response; McNaughton & Corr, 2008). Consequently, either the FFFS: Fear response or the BIS: Anxiety response is activated on presentation of a potential threat.

Defensive distance. Defensive distance refers to an individual's perception of the distance between one's actual self and a potential threat (McNaughton & Corr, 2004). Specifically, if the threat is considered to be high, the perceived distance from one's self and the threat will be shorter than the actual distance. However, if the threat is considered to be low, the perceived distance will be greater than the actual distance between the individual and the potential threat. Further, this perceptive defensive distance is influenced by individual differences in responding to threats. Those who are more sensitive to punishment may avoid a potential threat, while others who are less sensitive to punishment may be more inclined to approach the same potential threat with caution (McNaughton & Corr, 2004). Thus, the activation of the FFFS (avoid response) and the BIS (approach with caution response) are dependent upon both the size of the threat (i.e., high or low threat) and an individual's sensitivity to punishment (i.e., more or less sensitive).

2.4 Reinforcement Sensitivity Theory personality measures

Various self-report questionnaires and objective measures have been used to assess Gray's original RST traits and Gray and McNaughton's revised RST traits, including the BAS/ BIS Scales (Carver & White, 1994), SPSRQ (Torrubia et al., 2001), Reinforcement Sensitivity Theory Personality Questionnaire (RST-PQ; Corr & Copper, 2013), the Jackson-5 Scales (Jackson, 2009), Q-Task (Newman, Wallace, Schmitt, & Arnett, 1997) and the Card Arranging Reward Responsivity Objective Test (CARROT; Powell, Al-Adawi, Morgan, & Greenwood, 1996). The following section provides an overview of the measures that were selected to assess the BAS, the FFFS, and the BIS in the current program of research.

2.4.1 Behavioural Approach System

The BAS is a multidimensional system which consists of various underlying processes (Carver & White, 1994; Corr, 2008; Corr & Cooper, 2013). Both Carver and White (1994) and Corr and Copper (2013) have claimed that a number of different behavioural responses can occur when an individual is approaching a reward. Carver and White (1994) proposed that the BAS consists of three separate, but overlapping processes, namely BAS: Drive (i.e., goal pursuit), BAS: Reward Responsiveness (i.e., anticipation of rewards) and BAS: Fun Seeking (i.e., seek out excitement). These three components form Carver and White's BAS Scales which, to date, have been the most widely used self-report measures to assess the BAS (Smillie, Jackson, & Dalgeish, 2006b).

Since the introduction of the revised RST, research has reviewed Carver and White's (1994) proposed BAS processes (Corr & Cooper, 2013; Smillie, Jackson, & Dalgleish, 2006b). For instance, Smillie et al. (2006b) conducted two studies to assess if Carver and White's three BAS Scales: BAS: Drive, BAS: Reward Responsiveness, and BAS: Fun Seeking Scales accurately reflected the BAS. Confirmatory factor analysis revealed that these three scales were similar and, more importantly, that they measured different constructs of the BAS. However, in their second study, while the drive and reward responsiveness processes were significantly associated with reward-reactivity, the fun seeking process was significantly associated with both reward reactivity and impulsivity. It was concluded that Carver and White's (1994) BAS: Fun Seeking scale measured two individual components: reward reactivity and impulsivity.

Additional empirical research has concluded, similarly, that the BAS: Fun Seeking scale combines both reward sensitivity and impulsivity constructs (see Dawe & Loxton, 2004). Further, Franken and Muris (2006) reported that the BAS: Fun Seeking scale reflected impulsivity instead of reward sensitivity. Along with the Smillie et al.'s (2006b) findings, these studies suggest that Carver and White's BAS: Fun Seeking scale may not accurately reflect the BAS.

Corr and Cooper (2013) recently extended upon Carver and White's (1994) definition of the underlying BAS processes. Based on the revisions to the RST, they proposed that the BAS consists of four underlying processes: two processes that relate to early approach behaviours: reward interest (i.e., seek out rewards) and goal-drive persistence (i.e., goal pursuit), and two processes that relate to later approach behaviours: reward reactivity (i.e., seek out excitement)[8] and impulsivity (i.e., non-planning, lack of restraint). Unlike Carver and White's (1994) BAS processes, there is a clear distinction made between reward-reactivity and impulsivity. Only one published study to date (see Corr, Hargreaves-Heap, Tsutsui, Russell, & Seger, 2013) has used Corr and Cooper's proposed BAS constructs to assess the revised BAS.

Jackson (2009) also devised a new RST scale (i.e., Jackson-5 Scales) which aimed to reflect the changes made to the revised RST, including the revised BAS. However, unlike

[8] BAS: Reward Reactivity, BAS: Goal-Drive Persistence, and BAS: Impulsivity are similar to Carver and White's BAS: Reward Responsiveness, BAS: Drive, and BAS: Fun Seeking components, respectively (Corr & Cooper, 2013).

Corr and Cooper's RST-PQ which assess four underlying BAS processes, Jackson's Scales include one measure to assess the overall BAS construct. Thus, along with Carver and White's (1994) BAS scales and Corr and Cooper's (2013) RST-PQ, Jackson's BAS scale were included in Studies 2 and 3b as self-report measures of the BAS to extend upon existing knowledge. Given that Carver and White and Corr and Cooper's BAS scales measure separate underlying BAS constructs, the current research program has the potential to assess all the proposed underlying BAS processes as well as the overall BAS construct, as measured by Jackson's total BAS scale.

The Card Arranging Reward Responsivity Objective Test (CARROT). The CARROT was originally developed to assess the behavioural performance of individuals who had sustained brain injury (Powell et al., 1996). The CARROT has since been applied to objectively measure BAS in both a clinical population (Kane, Loxton, Staiger, & Dawe, 2004) and the general population (Al-Adawi & Powell, 1997; Kambouropoulos & Staiger, 2001, 2004, 2007; Loxton & Dawe, 2007). In the general population, significant moderate positive correlations have been reported between the CARROT and self-reported measures of BAS (e.g., Kambouropoulos & Staiger, 2004), suggesting that the CARROT is a valid measure of reward sensitivity. The CARROT was included in Study 2 as an objective measure of the BAS.[9]

2.4.2 Fight-Flight-Freeze System/ Behavioural Inhibition System

Several self-report questionnaires have been designed to assess the FFFS and BIS, including: Carver and White's (1994) BIS scale, Torrubia et al. (2001) Sensitivity to Punishment Scale, Jackson-5 Scales, and Corr and Cooper's RST-PQ. Carver and White's (1994) BIS scale was developed to assess the original BIS and thus, combines both fear and anxiety responses. This scale has received criticism for being an unsuitable measure of the

[9] Chapter 7, section 7.4.3.2, describes the CARROT in more detail.

redefined FFFS/ BIS traits (e.g., Jackson, 2009). Heym, Ferguson, and Lawrence (2008) recently proposed that Carver and White's BIS scale can be subdivided to represented FFFS: Fear (3-items) and BIS: Anxiety (4-items). However, one could argue, on psychometric grounds, that three items may not adequately capture the three punishment responses (i.e., Fight, Flight, and Freeze responses).

Two self-report questionnaires have been specifically developed to measure the redefined FFFS and BIS: the Jackson-5 Scales (Jackson, 2009) and Corr and Cooper's (2013) RST-PQ. The Jackson-5 Scales were originally reported by Jackson (2009) to have acceptable internal consistencies, however, more recent research have reported both lower and higher scale reliability scores (lower internal consistency, e.g., Morton & White, 2013; higher internal consistency, e.g., Ivory & Kambouropoulos, 2012). Given that Jackson-5 Scales were developed to assess the revised components of the RST and in light of this measure having received relatively limited attention previously, more research is required to evaluate these scales. Corr and Cooper (2013) have since introduced new measures of the FFFS and the BIS as part of their RST-PQ. However, only one published study to date by Corr and colleagues (2013) has used this self-report measure to examine the redefined FFFS and BIS traits. Given the current uncertainty of these FFFS/ BIS measures, the current program of research included all three self-report measures to more comprehensively assess the revisions made to the FFFS and the BIS.

The Q-Task. The computerised Q-Task was developed to measure the original BIS (Newman et al., 1997), which is conceptually similar to the revised FFFS. The Q-Task measures avoidance behaviour by assessing how individuals respond to punishment cues, in this case, the letter Q. While previous research has reported that the Q-Task was a suitable measure of the original BIS (see Pickering et al., 1997), limited research has since applied the Q-Task to measure the revised BIS or FFFS constructs. Thus, the Q-Task was included in

Study 2 to explore if this task reflects conflict (i.e., BIS) and/ or punishment cues (i.e., FFFS) in the revised RST.[10]

2.5 Separable and joint subsystem hypotheses

Gray (1970, 1982) proposed that the reward and punishment systems were independent systems. Gray stated that an individual's BAS sensitivity was only activated by the presence of reward stimuli (regardless of their original BIS sensitivity or the presence of punishment cues). In turn, an individual's original BIS sensitivity was only activated by punishment stimuli (regardless of their BAS sensitivity or the presence of reward cues).[11] However, recent research has argued that the activation of the reward and punishment system is dependent upon broader environmental cues (see Corr, 2001, 2002, 2008). For instance, Corr (2002) contended that individuals are exposed to a range of both reward and punishment stimuli and thus are simultaneously responsive to both incentive and aversive environmental cues. Corr (2001, 2002) proposed the joint subsystem hypothesis to reflect this interaction between the BAS and BIS. Specifically, the joint subsystem hypothesis predicts that the BAS and the BIS can have two separate effects on behaviour: facilitatory or antagonistic. For instance, individuals with a strong BAS or weak BIS should demonstrate greater approach behaviour towards incentive stimuli; BAS is facilitatory and BIS is antagonistic. Alternatively, individuals with a strong BIS or weak BAS should demonstrate greater avoidance behaviour towards aversive cues; BIS is facilitatory and BAS is antagonistic. However, Corr (2002) further proposed that independent approach and avoidance responses would occur under specific circumstances, such as when individuals are only exposed to reward or punishment stimuli, when individuals are presented with strong reward/

[10] Chapter 7, section 7.4.3.2, describes the Q-Task in further detail.

[11] Corr (2001, 2002) later referred to this process as the separable subsystem hypothesis.

punishment stimuli, and when assessing hyper-active approach or avoidance oriented individuals.

While Corr's (2002) initial research was consistent with the joint subsystem hypothesis, additional empirical evidence assessing this hypothesis is mixed (Gomez & Gomez, 2002; Kim & Lee, 2011). Gomez and Gomez (2002) applied Gray's original RST and provided some support for the joint subsystem hypothesis. Gomez and Gomez (2002) recruited 163 undergraduate students to complete three tasks (i.e., word fragmentation, word recognition, and word recall) that were designed to measure participants' responses towards positive, negative, or neutral words. Consistent with the separable subsystem hypothesis, the results showed that there were significant small to moderate positive correlations between original BIS scores and processing of negative word stimuli and no significant correlations between original BIS scores and processing of positive word stimuli. However, consistent with the joint subsystem hypothesis, there were significant small positive correlations between BAS scores and the processing of positive word stimuli (in the recognition and recall tasks) as well as a significant small negative correlation between BAS scores and processing of negative stimuli in the recall task.

Similar to Gomez and Gomez (2002), Kambouropoulos and Staiger (2004) also found mixed support for the joint subsystem hypothesis. In their study, participants (N = 78) were required to complete four measures of RST: two self-report personality measures and two objective measures (i.e., CARROT, objective measure of the BAS; and the Q-Task, objective measure of the original BIS). The results partially supported the joint subsystem hypothesis, showing that there was an interaction between the BIS and BAS on the Q-Task. Specifically, individuals with a strong BAS and a strong BIS demonstrated slower RTs to the letter 'Q' (i.e., the inhibitory stimulus) during the Q-Task. However, their findings also supported the separable subsystem hypothesis as only those individuals with a strong BIS responded more to the inhibitory stimulus on the Q-Task compared to the remaining three groups (i.e., weak BIS, strong and weak BAS).

Kim and Lee (2011) examined the joint subsystem hypothesis by recruiting 577 undergraduate students to assess their decision making in a gambling task. Participants were divided into four groups based on their self-reported personality scores: (i) strong BAS and strong original BIS, (ii) strong BAS and weak original BIS, (iii) weak BAS and strong original BIS, and (iv) weak BAS and weak original BIS. Supporting the joint subsystem hypothesis, they found that participants with a strong BAS and a weak original BIS were significantly more likely to undertake risky decision making to increase their chances of winning compared to those in the other three personality groups. In contrast, participants with a strong original BIS and a weak BAS were significantly more likely to make safer decisions in order to decrease their chances of losing than those in the other three personality conditions. Due to the limited power in Studies 2 and 3b, the separate and joint subsystems were not further assessed in this research program.

2.6 Chapter summary

This chapter critically reviewed the literature on Gray and McNaughton's revised RST and argued why further research is required to examine these revised traits. Specifically, this chapter presented research that has examined the extent to which individual differences in the revised BAS, FFFS, and BIS may influence various behaviours (e.g., drinking behaviour, risky and safe driving behaviours, work engagement, and resolving goal conflict). Next, this chapter provided a brief overview of the underlying neural structures of the RST. The chapter then provided a critique of the self-report and objective measures that have been previously used to assess the RST traits and argued for the inclusion of three self-report measures and two objective measures in the current program of research. The chapter then concluded by discussing the joint and subsystem hypotheses.

Chapter 3. Health Communication Messages: Message Framing Effects and Message Acceptance

3.1 Chapter Overview

This chapter reviews the literature on message framing effects and message acceptance. More specifically, this review demonstrates the impact of factors, such as reward and punishment sensitivity personality traits and issue involvement on the extent to which individuals accept health communication messages. The chapter then discusses the specific health advertising context of focus in this program of research, road safety messages. The chapter concludes by discussing the potential influence of opposing message cues, such as those introduced by promotional motor vehicle advertisements, on the persuasiveness of road safety messages that promote safe/ legal behaviour. Throughout the chapter, it is argued that messages designed to target specific personality traits, as conceptualised by Gray and McNaughton's revised Reinforcement Sensitivity Theory (RST), may increase individuals' message processing and subsequent message acceptance.

3.2 Health messages

Health messages are designed to persuade individuals to act in accordance with the recommendations within a message (Lewis et al., 2008a, 2009, 2010). Health messages focus on preventing injury and/ or promoting healthy behaviour by encouraging individuals to adopt safer, healthier attitudes and behaviour. They can be devised to reduce risky behaviours (e.g., risky driving behaviour), detect potential illnesses (e.g., cancer screening), or prevent future health problems (e.g., nutrition). Health messages may differ in frame (i.e., gain-framed or loss-framed messages) and message types (i.e., social, physical, financial, or psychological).

3.2.1 Message framing

Health messages can be framed to focus on the negative consequences or punishment associated with a particular behaviour (i.e., loss-framed messages) or framed to focus on the positive consequences/ reward of that behaviour (i.e., gain-framed messages; Donovan & Henley, 1997). For example, a loss-framed message may detail, “By not obeying the speed limits, you are increasing your risk of crashing and not protecting yourself and your loved ones.”, and the corresponding gain-frame focus would be, “By obeying the speed limits, you are decreasing your risk of crashing and protecting yourself and your loved ones” (Kaye et al., 2013). While identical information is conveyed in the loss-framed and gain-framed messages, message framing may influence individuals’ interpretations of the message and consequently, have different effects on persuasion (e.g., Meyerowitz & Chaiken, 1987; Millar & Millar, 2000). One theory which has been applied to explain message framing effects is Prospect theory.

Prospect theory and message framing. Prospect theory was developed to explain how individuals make decisions in risky/ uncertain situations (Kahenman & Tversky, 1979, 1982; Tversky & Kahenman, 1981, 1992). Prospect theory states that decisions differ depending on whether individuals are presented with information that focuses on losses (e.g., negative/ loss-framed messages) or information that focuses on gains (e.g., positive/ gain-framed messages). Specifically, the theory postulates that individuals are more likely to favour risky decisions when presented with losses and to avoid risky decisions when presented with gains (Kahenman & Tversky, 1982). Past research has applied this framing hypothesis to examine the influence that message frame (i.e., gain-framed vs. loss-framed messages) may have upon message persuasiveness and subsequent behaviour enactment (e.g., Meyerowitz & Chaiken, 1987; Rothman & Salovey, 1997; Rothman, Salovey, Antone, Keough, & Martin, 1993).

Loss-framed health messages may be more persuasive when they focus upon detection behaviours (i.e., messages that are developed to persuade individuals to seek early detection of potential health issues, such as skin cancer, mammography screening, and diabetes; Banks et al., 1995; Meyerowitz & Chaiken, 1987; Rothman & Salovey. 1997; Rothman et al., 1993). Gain-framed messages, in contrast, may be more persuasive for preventative health behaviours (i.e., messages that focus on preventing future illness or injuries, such as exercise, dental hygiene, and healthy eating; e.g., Robberson & Rogers, 1988). Thus, in accordance with the framing hypothesis of Prospect theory, individuals prefer loss-framed messages when confronted with a potential risk (e.g., detection of illness) and gain-framed messages when risks are perceived to be unlikely (e.g., preventative health behaviour).

In Studies 1a, 1c, and 2, the message stimuli focused on safe driving behaviours, specifically, prevention/ reduction of speeding behaviour. According to the framing hypothesis of Prospect theory generally, gain-framed messages should be more persuasive than loss-framed messages. However, previous research has reported that negative/ loss-framed road safety messages may be persuasive for some groups of drivers (e.g., Goldenbeld, Twisk, & Houwing, 2008; Lewis et al., 2007; Tay & Ozanne, 2002). For instance, Tay and Ozanne (2002) found that after exposure to threat-based anti-speeding, anti-drink driving, and seatbelt road safety campaigns, fatal crashes were significantly only reduced for females aged between 15-34 years and males aged between 35-54 years. Further, Goldenbeld et al. (2008) and Lewis et al. (2007) reported that female drivers were more likely to be persuaded by threat appeals than male drivers. These findings suggest that negative/ loss-framed messages may be more effective for particular groups of road users, in contrast to the framing hypothesis of the Prospect theory. It should be noted that more recent reviews have also highlighted that additional factors, such as individual differences in approach and avoidance systems (see section 3.4.1) may also moderate framing effects (e.g., Rothman & Updegraff, 2010; see also O'Keefe & Jensen, 2006, 2009).

While traditional road safety campaigns have relied heavily upon threat-based appeals (e.g., threat of loss of life; Donovan & Henley, 1997; Donovan, Jalleh, & Henley, 1999), more recent research has started to examine the potential effectiveness of gain-framed road safety messages (Lewis et al., 2008b, 2009). Lewis et al. (2008b), for instance, found that compared to loss-framed messages, gain-framed messages may be more effective at persuading certain groups of individuals, such as young males, to adopt safer driving behaviours. Thus, while loss-framed messages may be effective for some road users, other drivers may be more persuaded by gain-framed messages. Study 2 included a range of gain-framed and loss-framed anti-speeding messages to further examine the influence of message frame on message acceptance.

3.2.2 Message types

In addition to focusing on gain or loss, health messages can also be categorised according to whether they focus on social, physical, financial, or psychological threats (Donovan & Henley, 1997). Social threats, for instance, may emphasise the social disapproval an individual may experience by not complying with the message, while physical threats may highlight the physical injuries that one may sustain by not complying with the message. Financial threats may emphasise the monetary costs associated with failing to act in accordance with the message, while psychological threats may focus on one's self-esteem (Donovan & Henley, 1997). These threats can be expressed as gains (e.g., social approval or avoiding physical injuries for message compliance) or losses.

Consistent with previous research (e.g., Kaye et al., 2013; Schoenbachler & Whittler, 1996; Wiley, Krisjanous, & Hutchings, 2002), Studies 1a, 1c and 2 focused on two message types: physical and social themed messages. While social appeals have been implemented in more recent Australian road safety campaigns, traditional physical threat messages have been the predominant approach. Here crashes and injury/ death are often depicted as a consequence of unsafe driving behaviours (Tay & Watson, 2002). Similar to message framing effects, message type can also influence the persuasiveness of the road safety message (e.g., Goldenbeld et al., 2008; Lewis et al., 2008b, 2009). For instance, Goldenbeld et al. (2008) found that female drivers were more persuaded by physical threats than male drivers, while Lewis et al. (2008b, 2009) reported that male drivers may be more persuaded by messages that contained social cues. These findings suggest that while message type may influence message acceptance, gender may also be an additional factor to consider when developing the content of road safety messages.

3.3 Message acceptance

Message acceptance, derived from fear appeal literature, refers to the effectiveness or persuasiveness of a message (e.g., Witte, 1992). Message acceptance is often measured/ conceptualised in terms of behavioural intentions (i.e., willingness to comply with the behaviour advocated in the message; Witte, 1992), although it may be more broadly considered and measured in terms of attitudes (i.e., favourable or unfavourable beliefs and/ or feelings towards specific behaviours; Ajzen, 1991, 2001) and even as actual behaviour. Such measures are indicative of indirect measures of message effectiveness. Direct measures may, in contrast, ask an individual to report on the perceived persuasive effect (e.g., how convincing was the message) that the message has on oneself and/ or others (Dillard, Shen, & Vail, 2007a). Direct self-report measures of message acceptance have been reported to be reliable measures of actual behaviour. For instance, a meta-analysis by Dillard, Weber, and Vail (2007b) found that perceived message effectiveness had a strong positive relationship with actual behaviour, suggesting that self-report measures of perceived message effectiveness are a reliable and valid measure of message acceptance.

Theoretical models (e.g., Theory of Planned Behaviour; Ajzen, 1991) and empirical evidence (e.g., Elliott, Armitage, & Baughan, 2003; Lewis et al., 2008c) has also shown that self-reported attitudes and behavioural intentions can predict subsequent behaviour. Specifically, in the context of road safety, Lewis et al. (2008c) reported that pre-existing attitudes towards a range of road safety messages not only influenced drivers' intentions to comply with the recommendations of these messages but, also, self-reported driving behaviour four weeks after message exposure.

3.4 The relationship between health messages and message acceptance

While a myriad of factors relating to the messages themselves influence message acceptance (e.g., Lewis et al., 2009), additional factors such as personality (e.g., Mann et al., 2004; Shen & Dillard, 2007, 2009) and issue involvement (e.g., Maheswaran & Meyers-Levy, 1990; Millar & Millar, 2000; Petty & Cacioppo, 1986; this comes largely from Elaboration Likelihood Model of Persuasion) are also believed to influence the effectiveness of gain-framed and loss-framed health messages. Whilst it is beyond the scope of this dissertation to review all of the factors that may influence message acceptance, interested readers should refer to previous research that has reviewed factors influencing message acceptance (e.g., response efficacy, Lewis et al., 2009) as well as meta-analytic research (e.g., Witte & Allen, 2000) for a comprehensive review of these additional factors. The following section provides an overview of the research that has reported the influence of personality and issue involvement on the acceptance (effectiveness) of health messages.

3.4.1 Individual differences

According to Gray and McNaughton's (2000) revised RST and the separable subsystem hypothesis, individuals with a stronger Behavioural Approach System (BAS) are more sensitive to reward cues and thus, are more likely to approach rewards than those with a weaker BAS. As such, individuals with a stronger reward system should attend to, and process, health messages that focus on incentive cues to a greater extent and, in turn, be more persuaded by these messages compared to those with a weaker reward system. In contrast, individuals with a stronger Fight-Flight-Freeze System (FFFS) are more sensitive to cues of punishment and, should attend to, and process, health messages that focus on aversive cues to a greater extent and, in turn, be more persuaded by these messages than those with a weaker punishment system. Previous research has explored the relative effectiveness of message frames (i.e., gain-framed and loss-framed) by different personality types for various types of health messages including dental hygiene (Mann et al., 2004; Sherman, Mann, & Updegraff, 2006; Updegraff, Sherman, Luyster, & Mann, 2007), obesity, influenza, smoking, glaucoma, pedestrian safety (e.g., Shen & Dillard, 2007, 2009), alcohol consumption (Van ‘t Riet et al., 2011) and skin cancer prevention (Hevey & Dolan, 2013; Shen & Dillard, 2007, 2009; Shen & Kollar, 2013).

Mann et al. (2004) and Sherman et al. (2006) each conducted two separate studies to examine the effect that Gray’s original RST traits had on compliance with messages that promoted dental hygiene. They found that individuals who were more sensitive to reward cues (as measured by self-report ratings) were more likely to comply with a gain-framed dental flossing message. In turn, participants who were sensitive to punishment cues were more likely to comply with a loss-framed dental flossing message. Further, Sherman et al. (2006) found that the intention to floss predicted subsequent self-reported flossing behaviour. These findings support the theoretical predictions of Gray’s original RST and suggest that individual differences in approach and avoidance motivation influence message acceptance according to message frame.

Shen and Dillard (2009) conducted two studies to examine if individual differences would influence responses to messages addressing health issues including skin cancer, obesity, and influenza in Study 1, and smoking, glaucoma, and pedestrian safety in Study 2.

The messages were presented to participants as written text-only based messages in Study 1 (n = 286) and in Study 2 (n = 252), participants viewed televised public service announcements. In each study, half of the participants were exposed to either gain-framed or loss-framed messages, while the other half of the participants viewed a mixture of both gain-framed and loss-framed messages. In both studies, the findings supported Gray's original RST with reward sensitivity associated with greater processing (as measured by a self-reported thought listing task) of the gain-framed messages and punishment sensitivity associated with greater processing of loss-framed messages.

Similarly, Van 't Riet et al. (2011) and Hevey and Dolan (2013) found support for Gray's original RST using alcohol messages and sun safety messages, respectively. Specifically, Van 't Riet et al. (2011) found that the individuals who scored as stronger original Behavioural Inhibition System (BIS) reported greater intentions to abide by a high threatening alcohol message (presented as written text) compared to the corresponding low threatening message. In Hevey and Dolan (2013), those with a stronger BAS reported greater intentions to abide by the gain-framed sun safety messages compared to those with a stronger original BIS. In turn, those with a stronger original BIS reported greater intentions to abide by the loss-framed sun safety messages than those with a stronger BAS.

While, collectively, these studies support the theoretical predictions of the RST, in that those with a stronger BAS were more sensitive to reward messages compared to those with a weaker BAS and those with a stronger original BIS appear more sensitive to punishment than those with a weaker original BIS, further research is still required in this area. A limitation of past research that has applied Gray's original RST to assessing message processing is that studies have often relied upon self-report questionnaires to assess cognitive processing (e.g., Shen & Dillard, 2007; Van 't Riet et al., 2011). However, it has been argued that information processing may be an automatic process that occurs in the unconscious (e.g., Chaumon, Drouet, & Tallon-Baudry, 2008; Kihlstrom, 1987; van Gaal, Ridderinkhof, Scholte, & Lamme, 2010) and may, therefore, be inaccessible to individuals' self-report. Thus, to avoid such limitations associated with self-report measures (e.g., Fox, Cahill, & Zougkou, 2010), Studies 2 and 3b included objective assessments of cognitive differences to assess if the processing of information (aligned with the revised RST traits) would influence individuals' acceptance of negatively and positively framed messages.

Additionally, previous research that has investigated sensitivity to reward and sensitivity to punishment traits in relation to the processing of gain-framed and loss-framed messages has focused on Gray's original RST. However, it is worthwhile noting that not only have all the listed RST and message framing studies applied Carver and White's BIS/ BAS Scales to measure the RST traits but, these studies have reported the BIS to reflect behavioural avoidance instead of behavioural inhibition. Given that Carver and White's BIS scale was created to measure behavioural inhibition as defined by Gray's RST (i.e., inhibition towards stimuli instead of avoiding the stimuli per se; Carver & White, 1994), further research is required that incorporates additional measures of punishment/ avoidance to assess more accurately the potential influence that fearful and anxious personality traits may have on the processing of loss-framed messages.

With the exception of Kaye et al. (2013), limited research has applied Gray and McNaughton's (2000) revised RST to examine the effectiveness of message frames in a road safety context by reward and punishment personality types. However, similar to previous RST and message framing studies, the BAS in Kaye et al. (2013) was examined as a whole construct rather than examining the influence of each underlying BAS process separately (e.g., as represented by BAS: Drive, BAS: Reward Responsiveness, and BAS: Fun Seeking in Carver and White's BAS component of the BIS/ BAS Scales). As suggested by Shen and Kollar (2013) and supported by research previously discussed in chapter 2, section 2.4.1, which emphasised the different roles played by these underlying BAS processes (e.g., Corr & Cooper, 2013; Smillie et al., 2006b), the current program of research assessed each BAS component separately to further examine any potential relationships that may exist between the BAS and processing of gain-framed messages.

Research has yet to examine Gray and McNaughton's (2000) revised BIS in relation to the processing of conflicting message cues. Thus, Study 2 extends upon past research by applying the revised RST to examine the BIS by exposing some individuals to both the social loss-framed message (i.e., a message aimed to reduce speeding behaviour by emphasising the social consequences of speeding) and a promotional motor vehicle message (i.e., a fictitious advertisement that was designed to promote a high performance vehicle and do so by potentially 'promoting' less safe behaviours). It was anticipated that by exposing participants to these conflicting message cues, the BIS would become activated (due to goal conflict between the BAS and the FFFS).

3.4.2 Issue involvement

Theoretical models (e.g., Elaboration Likelihood Model [ELM], Petty & Cacioppo, 1986) have suggested that issue involvement is an additional factor that may influence message processing. The ELM postulates that individuals may use two pathways to process information: the central pathway and the peripheral pathway. The central pathway is used when there is a high degree of elaboration (i.e., more cognitive processing) of the presented information (Petty & Cacioppo, 1986). When a health communication message is processed via the central pathway, an individual's previous experience and/ or knowledge of the behaviour promoted in the message may influence the persuasiveness of the information. By contrast, the peripheral pathway is used when there is a low degree of elaboration (i.e., less cognitive processing) of the presented information (Petty & Cacioppo, 1986). When a message is processed via the peripheral pathway, factors unrelated to the message content, such as source characteristics, have a greater influence on the perceived persuasiveness of the message compared to systematic thinking. While the ELM identifies two specific pathways, it is important to note that elaboration exists on a continuum. Individuals therefore may use a combination of both the central and the peripheral pathways to process and, subsequently, be persuaded by health messages. The extent to which individuals use systematic thinking or peripheral cues to process health communication messages depends upon a number of factors, one of which is issue involvement.

Previous research has reported that when a message is perceived to be personally relevant (i.e., high issue involvement), individuals demonstrate greater processing of the message compared to when the message is irrelevant (i.e., low issue involvement; Ajzen, Brown, & Rosenthal, 1996; Andrews & Terence, 1990; Petty & Cacioppo, 1979). In turn, low issue involvement more likely results in processing via the peripheral pathway. Thus, issue involvement is one factor that can increase or decrease message processing and consequently, influence message persuasion.

In addition to differences in message processing, empirical evidence has shown that issue involvement is sensitive to message framing effects (e.g., Maheswaran & Meyers-Levy, 1990; Millar & Millar, 2000). Millar and Millar (2000) found that gain-framed safe driving messages were rated as more effective by participants who scored higher in self-reported involvement than those who scored lower in self-reported involvement. Further, participants who scored higher in involvement were more likely to rate their intentions to comply with the gain-framed messages higher than those who viewed the corresponding loss-framed messages. In contrast, Maheswaran and Meyers-Levy (1990) found that participants who scored higher in involvement were more persuaded (as measured by self-reported attitudes and behavioural intentions) by loss-framed messages that addressed the issue of identifying cholesterol levels to check for one’s risk of heart disease than the corresponding gain-framed messages. These inconsistent findings may be due to the focus of the messages being upon either prevention (i.e., safe driving) or detection (i.e., heart disease via a blood test). Nonetheless, these research findings indicate that issue involvement may moderate the effects of message framing. Issue involvement was therefore controlled in the current program of research via inclusion criteria and statistical checks.

3.5 Processing road safety messages

Road crashes are a leading cause of death and injury and account for approximately 1.2 million fatalities worldwide each year (World Health Organization [WHO], 2013). In Australia, road crashes accounted for 1,310 fatalities and approximately 30,000 injuries in 2012 (BITRE, 2013). Various countermeasures, including road safety advertising messages, are implemented in the attempt to reduce unsafe and/ or illegal driving behaviour. However, with the long-standing reliance upon physical threat-based messages (see Lewis et al., 2010; Lewis, Watson, & Tay, 2007), drivers with a heightened sensitivity to reward cues may not be persuaded by this message type. Further, as discussed in chapter 2, section 2.2.3, past research has shown that these individuals who are more sensitive to reward cues (i.e., strong BAS) are more likely to engage in risky road behaviours, such as speeding behaviour, compared to those individuals who are sensitive to punishment cues (i.e., strong FFFS; e.g., Castellá & Perez, 2004) . The current program of research thus addressed this issue by examining information processing biases to different framed messages as a function of personality (reward and punishment system sensitivities) and the extent to which an individual subsequently supported adopting the recommendations of an emotional anti-speeding message.

The anti-speeding messages included in Study 2 were broadly defined as gain-framed (associated with positive emotions) and loss-framed messages (associated with negative images). The effects of discrete emotions were not examined here. It is acknowledged, however, that discrete positive emotions, such as pride and humour and negative emotions, such as fear, have been reported to influence drivers' acceptance of road safety messages (e.g., Lewis et al., 2007, 2008a, 2010). However, given that one of the purposes of Study 2 was to examine the potential effects of the BAS and the FFFS traits on processing and subsequent acceptance of general gain-framed and loss-framed anti-speeding messages, this research focused on an overall global positive and negative valence dichotomy.

3.5.1 Visual and written message content

Road safety messages can be presented as audio, visual, or written concepts across various advertising mediums, such as television, billboards and the internet. Drawing on research based upon anti-smoking campaigns (specifically, cigarette package warning labels), studies have reported that while text-only labels may increase the awareness of the negative consequences associated with smoking (Hammond, Fong, McNeill, Borland, & Cummings, 2006; Thrasher, Hammond, Fong, & Arillo-Santillán, 2007), a combination of both visual images and text warnings is more effective at encouraging individuals to cease smoking (Gallopel-Morvan, Gabriel, Le Gall-Ely, Rieunier, & Urien, 2011; Kees, Burton, Andrews, & Kozup, 2006; O'Hegarty et al., 2006; Vardavas, Connolly, Karamanolis, & Kafatos, 2009). O'Hegarty et al. (2006), for instance, examined the influence that text only or a combination of a text and visual image had on young adults' smoking behaviour: participants were more motivated to quit smoking when exposed to a package that contained both a text warning and a visual image. Similarly, Kees et al. (2006) found that individuals reported greater intentions to quit smoking when exposed to a cigarette package that included both a visual image and a written warning compared to those packets that only included either a visual image or written statement. Collectively, these findings highlight the positive effects of using a combination of text and visual cues in persuading individuals to adopt the recommendations of the message.

The visual images and written labels included on cigarette packs are similar to those used in road safety advertising. For example, cigarette packets may consist of images of diseases associated with smoking, while road safety advertisements may contain images of injuries associated with road crashes. Written slogans have included *"Every cigarette is doing you damage"* (Australian Government, Department of Health and Ageing, 2000) and *"Don't fool yourself, speeding kills"* (Transport Accident Commission [TAC], 2009). Given that previous studies have reported that processing of anti-smoking advertisements are different for visual and text based messages (e.g., Gallopel-Morvan et al., 2011; O'Hegarty et al., 2006), visual images and written anti-speeding messages were examined separately here to examine message processing in a road safety context.

3.6 Mixed media cues

Road safety messages exist in a complex media environment in which they are forced to compete with other advertisements, some of which may indirectly promote unsafe driving behaviours, such as motor vehicle advertisements, developed to promote and sell vehicles. In 2002, the Australian government introduced the self-regulated Advertising for Motor Vehicles Voluntary Code of Practice to restrict the content that could be presented in motor vehicle advertisements and, ultimately to, prevent these advertisements from promoting unsafe and/ or illegal driving behaviour (see Federal Chamber of Automatic Industries, 2009). Various motor vehicle advertisements are nonetheless still perceived by some members of the public as promoting unsafe driving behaviour (see Australian Standards Bureau [ASB], 2014). For example, 13 motor vehicle advertisements shown on Australian television in 2013 received complaints. These complaints related to such aspects as the advertisements portraying unsafe and/ or illegal driving behaviour or implying that the vehicle had high speed capabilities (ASB, 2014). However, only one complaint was upheld by the ASB. The particular advertisement was amended to remove the voiceover content, revving sounds, and several screen shots that were perceived by the board to depict unsafe driving behaviour.

In addition to the reported complaints, empirical research has found that some motor vehicle advertisements shown on Australian television are perceived by individuals to indirectly promote unsafe driving behaviour (Donovan, Fielder, & Ouschan, 2011a; Donovan, Fielder, Ouschan, & Ewing, 2011b; Redshaw, 2011). Donovan et al. (2011b) exposed participants to two (of three) Australian motor vehicle advertisements that had received complaints because of portraying speeding driving behaviour. Their results indicated that 64-83% of the 463 respondents rated the vehicles in these advertisements to be more powerful and have faster acceleration than other vehicles. Further, over half to two-thirds of participants perceived that these advertisements were promoting illegal speeding behaviour. Using the same sample, Donovan et al. (2011a) found that the majority of participants perceived these advertisements to imply that driving a high performance vehicle ‘is cool’. Individuals who are more inclined to want to impress their peers, may also be willing to imitate the speeding behaviour shown in these motor vehicle advertisements, so as to be considered ‘cool’ by others. However, while young male drivers may consider that others would approve of their speeding behaviour, research has shown that this perception is not shared by others (see Lewis et al., 2013). For instance, Lewis et al. (2013) found that despite young male drivers believing that others, particularly young females, would approve of their speeding behaviour, young female drivers reported that they were unimpressed by this behaviour and perceived speeding to be dangerous. As such, young male drivers may be more persuaded by advertisements portraying performance based driving behaviour compared to their female counterparts.

Through a series of focus groups, Redshaw (2011) had participants view two motor vehicle advertisements which had previously been presented on Australian television.

Consistent with Donovan et al. (2011a,b), Redshaw (2011) found that some participants reported that the advertisements encouraged fun and/ or reckless driving behaviour. Thus, it seems that despite the self-regulated Advertising for Motor Vehicles Voluntary Code of Practice, motor vehicle advertisements are still perceived by some individuals as depicting and motivating risky driving behaviours. Arguably, these advertisements, with their potentially counter focus, may reduce the effectiveness of road safety messages, particularly for young adults who may be more susceptible to these conflicting advertisement cues.

To assess the impact of exposure to mixed media cues, Study 2 exposed participants to a purpose-designed high performance motor vehicle message and a social loss-framed message about the negative consequences associated with unsafe driving behaviour. By exposing participants to mixed message cues, this research was able to assess the influence of the BIS on message acceptance. As previously stated, research has reported that individuals with a stronger BAS are more likely to participate in risky driving behaviour than those individuals with a weaker BAS (Harbeck & Glendon, 2013). Thus, as the motor vehicle message in Study 2 was purposely designed to promote a high performance vehicle, it was anticipated that this message would activate the BAS. Further, based on the theoretical predictions of the FFFS (Gray & McNaughton, 2000), the loss-framed messages included in Study 2 were anticipated to activate the punishment system, in this case the FFFS. Thus, due to simultaneous activation of the BAS and the FFFS, the BIS response should be observed when participants are exposed to these mixed message cues (i.e., the motor vehicle message that promotes a high performance vehicle and a loss-framed message that emphasises the negative consequences of speeding behaviour), and this response is expected to be larger in high BIS individuals.

3.7 Chapter Summary

This chapter reviewed the literature on message framing effects and message acceptance. Specifically, this chapter highlighted the impact of individual differences in BAS and FFFS traits on the acceptance of health communication campaigns (e.g., obesity, smoking, alcohol consumption, and skin cancer prevention) and argued why more research is required to examine the revised BAS and FFFS traits in a road safety advertising context. For instance, given that previous research has relied upon applying Gray's original RST to assess message framing effects, it was argued that further research was required to examine the revised influence of the RST traits on the relative effectiveness of message framing manipulations involving reward and punishment traits. Further, given that previous research has typically relied upon measures of self-report to examine information processing, this chapter highlighted the need to include more objective assessments of cognitive differences to further assess if processing influenced subsequent message acceptance. This chapter also discussed the potential negative impact that motor vehicle advertisements promoting high performance vehicles may have on the persuasiveness of conflicting road safety messages. In conclusion, chapter 3 provided a strong rationale for the current research by identifying the gaps that exist in the literature and highlighted the need for the current program of research which was designed to assess the influence of the revised RST traits on message processing (using objective measures of cognitive processing) and subsequent message acceptance of road safety and motor vehicle messages.

Chapter 4. Young Drivers

4.1 Chapter overview

This chapter reviews the literature on road safety risks of young drivers and highlights the important need to design more effective countermeasures, such as road safety messages, to encourage young drivers to adopt safer driving behaviours. This review discusses the factors which contribute to young drivers engaging in unsafe driving behaviours relative to other road users (e.g., older, more experienced drivers) and highlights how perceptual bias (i.e., optimism bias and Third-person Effect [TPE]) may contribute to young drivers' susceptibility to road related crashes. The chapter concludes by discussing the influence of sensation seeking and reward sensitivity traits on risky driving behaviours and the need for road safety messages to be designed to target these high risk individuals.

4.2 Young drivers

Young people aged 25 years and under are particularly susceptible to driver related fatalities, accounting for 30% of road crash fatalities worldwide (WHO, 2007). Representing only 13% of the total driving population, this age group accounted for 22% (i.e., 286 fatalities) of all driver fatalities on Australian roads in 2012 (BITRE, 2013). Further, these young drivers have a greater percentage of driver and passenger hospitalisations compared to any other age group (Australian Institute of Health and Welfare, 2012). While supervised learner drivers are the safest road users, young drivers have a greater risk of crashing within the first few months of receiving their provisional license (Mayhew, Simpson, & Pak, 2003; Williams, 2003). Thus, it is important to continue to implement prevention strategies, such as community road safety messages, to reduce the crash risk of young road users. The following section provides an overview of the factors that have been reported as contributing to unsafe driving practices among young adults.

4.3 On road driving skills

4.3.1 Hazard perception skills

The ability to detect road hazards reduces the risk of crash involvement (Deery, 1999). However, due to their relatively limited driving experience, young drivers lack the capacity to effectively recognise and respond to these potential hazards (Deery, 1999). For instance, compared to more experienced drivers, young novice drivers detect fewer hazards (Pradhan et al., 2005) and are slower to respond to such hazards (Scialfa et al., 2011). These lower hazard perception skills may increase the crash risk for young adults. While training has been reported to improve detection reaction time (RT) to on-road hazards (e.g., Isler, Starkey, & Williamson, 2009) and thus reduce crash risk, young road users still lack the higher order cognitive skills required to respond effectively to hazardous driving situations.

4.3.2 Brain development

The continued development of the adolescent/ young adult's brain might also contribute to their high number of road crashes. The human brain continues to grow and develop throughout adolescents and into early adulthood, with the prefrontal cortex being the last brain structure to reach maturity (Giedd, 2004). The prefrontal cortex is responsible for higher order executive functions, such as regulating behaviour, impulse control, planning, and decision making (Luna & Sweeney, 2004). Thus, given under-developed higher order cognitive abilities, young adults may lack the sufficient resources required to effectively perceive and process complex information in a short time span and hence, may be more susceptible to road crashes (e.g., Dahl, 2008; see also Steinberg, 2007).

4.4 Risk taking behaviour

4.4.1 Night time driving

While inexperience has been shown to contribute to on-road crashes in young drivers, young drivers are more susceptible to voluntary risk taking behaviour compared to other age groups (Clarke, Ward, & Truman, 2005; Jonah, 1990). For instance, they are more likely to drive at riskier times (e.g., at night and on weekends, BITRE, 2013) compared to safer times (i.e., daytime). Driving at night has been shown to increase risk, particularly when driving after midnight (Rice, Peek-Asa, & Kraus, 2003). Factors associated with night time driving include poor visibility, increased fatigue, and a higher increase of alcohol related crashes (McGwin & Brown, 1999; Williams, 2003). While all road users may be susceptible to the negative effects of night time driving, young drivers are involved in a higher percentage of fatal crashes in the night time compared to day time (Doherty, Andrey, & MacGregor, 1998). Thus, evidence indicates that driving at night increases the crash risk for young drivers.

4.4.2 Presence of passengers

Passengers can either have a negative (i.e., increase crash risk/ involvement) or positive (i.e., protect against crash risk) effect on a driver's behaviour. For young adults, the age of their passengers is one factor that has been reported to influence driving behaviour (Aldridge, Himmler, Aultman-Hall, & Stamtiadis, 1999; Regan & Mitsopoulos, 2001; Rice et al., 2003). For instance, previous research has found that compared to travelling with children or adults, young drivers travelling with same aged peers (i.e., those aged 16-20 years) had a significantly greater crash risk (Aldridge et al., 1999). Further, Regan and Mitsopoulos (2001) reported that compared to passengers aged 55 years and older, young passengers aged 16 to 24 years were more likely to encourage the driver to participate in risky driving behaviours. These findings suggest that passengers of similar ages to the young drivers themselves tend to increase crash risk.

The gender of the passenger has also been shown to influence young adults' driving behaviour (e.g., Baxter et al., 1990; Regan & Mitsopoulos, 2001; Simons-Morton, Lerner, & Singer, 2005; Williams, Ferguson, McCartt, 2007). Specifically, driving with male passengers increases the crash risk of young adults, while driving with female passengers has been found to have a positive/ protective influence on young adults' driving behaviour (e.g., Regan & Mitsopoulos, 2001). For example, in the presence of female passengers, young drivers were less likely to engage in speeding behaviour (Baxter et al., 1990; Simons-Morton et al., 2005) and more likely to adhere to safer following distances (Simons-Morton et al., 2005) than with male passengers. One reason for these findings may be that, compared to female passengers, young males are less likely to confront other male drivers about their unsafe driving behaviour (Ulleberg, 2004) and also, may be more susceptible to the influences of their peers.

Currently in Queensland, the state of Australia in which the program of research was conducted, restrictions are in place as part of the graduate licensing scheme to limit the number of passengers that a young driver on a provisional license is permitted to have in their vehicle during night time driving (see Scott-Parker, Bates, Watson, King, & Hyde, 2011). Specifically, these restrictions state that drivers who have held a provisional licence for less than one year are only allowed to carry one passenger under the age of 21 years between 12 midnight and 5am (Department of Transport and Main Roads, 2013). While incorporating night time passenger restrictions have been shown to successfully reduce crash risk (see Williams, Tefft, & Grabowski, 2012), alternative countermeasures, such as road safety messages, are also required to continue to educate drivers about the negative impact associated with risky driving behaviour and motivate individual drivers to adopt safer driving related attitudes and behaviours, both during risky provisional licence phase and beyond to open licence.

4.4.3 Gender differences

Compared to young females, young male drivers perceive risky driving to more acceptable (Redshaw, 2006) and thus, are more likely to participate in riskier driving behaviours (Harré, Field, & Kirkwood, 1996; Johan, 1990). Further, young males perceive risky behaviours, such as failing to wear a seat-belt and not coming to a full-stop at stop signs, to be less serious compared to young female drivers (DeJoy, 1992). Consequently, male drivers have a higher crash risk than female drivers (e.g., Lewis-Evans, 2010; Monárrez-Espino, Hasselberg, & Laflamme, 2006). However, while young males are more susceptible to road crashes, young females are starting to take more risks on the roads (Romano, Kelley-Baker, & Voas, 2008). Romano et al. (2008), for instance, reviewed American fatal crash data from 1982 to 2006 and concluded that, over time, younger female drivers (aged 15-20 years) were becoming more susceptible to fatal crashes resulting from their own risk taking behaviour. Consequently, Study 2 was interested in examining both young males' and young females' processing and subsequent acceptance of road safety messages intending to reduce speeding.

4.4.4 Speeding behaviour

Speeding behaviour accounts for approximately 20-25% of all Australian driver fatalities (e.g., Queensland Government, 2011). Speeding behaviour not only increases the chance of a crash occurring, but also increases the severity of related injuries when a crash occurs (WHO, 2007). While the effects of speeding behaviour can have devastating personal consequences for all those involved, speed-related crashes also result in high social and economic costs. It is estimated that a single speed-related fatality costs the community approximately $2 million. Further, injury hospitalisations are estimated to cost approximately $432, 000 per individual (Queensland Police Service, 2009), due to the emergency costs related to a crash, compensation due to loss of work, and costs related to rehabilitation and support.

Despite drivers recognising that speed contributes to road crashes (Kloeden, Ponte, & McLean, 2001), speeding behaviour appears to remain largely accepted in Australian society with drivers continuing to speed (Blincoe, Jones, Sauerzapf, & Haynes, 2006; Fleiter &

Watson, 2006). Previous research has found that 28% of respondents considered driving 30 km/hour above the speed limit on a rural Australian highway not to be dangerous (Filders, Rumbold, & Leening, 1991). More recent research has found that 33.4% of respondents aged between 17-79 years considered speeding 10-20km above the speed limit in 100km/hr speed zone to be worth the risk (Fleiter & Watson, 2006). Additionally, research has found that drivers perceive traffic offences related to speeding behaviour to be less serious than other traffic offences, such as driving under the influence of alcohol (Rothengatter, 1991). It seems then, that despite the negative consequences associated with speeding behaviour, drivers still continue to perform this risky driving behaviour.

Speeding behaviour and young drivers. Young drivers are particularly likely to engage in speeding behaviour. For instance, a report by the Australian Government indicated that 80% of young drivers reported regularly driving up to 10km over the posted speed limit (Australian Institute of Family Studies, 2005). Empirical research has also shown that compared to older age groups, young drivers are more likely to report speeding behaviour (e.g., Fleiter, Watson, Lennon, & Lewis, 2006), with young males more likely to report regularly speeding compared to young female drivers (Harré et al., 1996; Horvath, Lewis, & Watson, 2012a). Additionally, young drivers are more likely to report speeding behaviour when driving alone than with passengers (e.g., Arnett, Offer, & Fine, 1997; Horvath et al., 2012b) and are more likely to speed if they perceive that their friends would approve of this behaviour (Fleiter et al., 2006). Considering young drivers have a higher risk of dying in a speed related crash (e.g., 43% compared to the average of 25% in other age groups; Audit Office of New South Wales, 2011), it is important to continue to focus on persuading individuals to adopt safer attitudes and behaviour.

4.5 Perceptual biases

4.5.1 Optimism bias

Optimism bias refers to the belief that others are more susceptible to negative outcomes than one's self, while an individual also sees themself as more likely to experience positive outcomes than others (Weinstein, 1980). Optimism bias may also contribute to greater risk taking and young people's subsequent high involvement in road trauma. Previous research has consistently shown that young drivers are more susceptible to driving related optimism bias (DeJoy, 1992; Delhomme, Verlhiac, & Martha, 2009; Finn & Bragg, 1986; Gosselin, Gagnon, Stinchcombe, Joanisse, 2010; Guerin, 1994; Harrè, Foster, & O'Neil, 2005; Harrè & Sibley, 2007; Horswill, Waylen, & Tofield, 2004; Matthews & Moran, 1986; Sibley & Harrè, 2009; White, Cunningham, & Titchener, 2011). For example, studies have reported that young drivers have a tendency to perceive themselves to have greater driving skills, and as less likely to be involved in a driving related crash, than other drivers in their age group (Guerin, 1994; Harrè et al., 2005; Horswill et al., 2004; White et al., 2011). Further, young drivers perceived themselves to be greater drivers compared to older age groups (Finn & Bragg, 1986; Gosselin et al., 2010; Matthews & Moran, 1986). Collectively, these findings indicate that young drivers overestimate their skills and underestimate the likelihood of being involved in a road crash and, thus, may be more susceptible to road trauma.

Gender differences have also been reported to influence optimism bias in young adults. Specifically, research has reported that compared to females, males have greater driving-related optimism bias (DeJoy, 1992; Gosselin et al., 2010; Harrè & Sibley, 2007; Sibley & Harrè, 2009). DeJoy (1992), for instance, recruited an equal number of male and female participants (N = 136) and found that 93% of males perceived themselves to be more skilful than both drivers in their own age and the average driving population. In turn, 75% of females perceived themselves to have greater driving skills than other young drivers and 69% stated that they were more skilful than average drivers. Further, Gosselin et al. (2010) found that compared to female drivers, males perceived themselves to have a lower probability of a crash, while Sibley and Harrè (2009) found that male drivers perceived themselves to have greater driving ability compared to female drivers. These findings indicate that young male drivers may have a greater risk of being involved in a road crash compared to young female drivers due to a misperception that they are less likely to be involved in a road crash (less likely to experience a negative outcomes, more likely to hold positive skills; better driving behaviours) than their same aged and/ or different gender counterparts.

4.5.2 Third-person Effect

An additional perceptual bias derived from the communication literature that may influence how young drivers respond to road safety messages is the Third-person Effect (TPE). The TPE is a perceptual bias whereby individuals perceive that other people (i.e., third persons) will be more influenced by persuasive messages than themselves (Davison, 1983). Further, this perceptual disparity has behavioural implications (e.g., censorship; Gunther & Mundy, 1993). Thus, in health communication campaigns, individuals may be less inclined to follow the recommendations of these messages as they may consider the messages as more influential to others. Previous research has explored the TPE across various road safety campaigns, including seatbelts (Duck & Mullin, 1995), drink driving (Duck & Mullin, 1995; Innes & Zeitz, 1988; Lewis et al., 2007) and speeding (Lewis et al., 2007) advertisements. Lewis et al. (2007), for instance, found that after viewing a threat-based anti-speeding television advertisement, male participants perceived the advertisement to influence other drivers more than themselves, while female participants perceived that the advertisement would influence them more than others (referred to as the reverse TPE or the first-person effect; Perloff, 1999). Further, upon viewing this advertisement, females reported greater intentions to comply with the recommendations of the messages (an anti-drink driving and an anti-speeding message) than male drivers. It appears that some drivers may perceive other drivers to be more persuaded by road safety campaigns and thus, are less likely to be persuaded (and report attitudinal and/ or intentional change) by these road safety messages.

The evidence supporting the influence that optimism bias and TPE may have on crash risk and message acceptance, demonstrates the additional challenges faced when trying to persuade young drivers to adopt safer driving behaviours. While young male drivers have a greater crash risk compared to other age groups (e.g., Lewis-Evans, 2010; McGwin & Brown, 1999), the belief that they are less vulnerable to the negative consequences associated with driving related crashes increases the difficulty of targeting these high risk drivers. Additional approaches are thus needed to better target at-risk young drivers, and the Reinforcement Sensitivity Theory (RST) and message framing literature offers potential in this respect.

4.6 Personality characteristics and risk taking behaviour

To further examine why young adults are more likely to engage in risk taking behaviour, research has assessed the possible role of additional factors, such as personality characteristics. Two personality traits that have been linked with risk taking behaviour are sensation seeking and reward sensitivity. While the traits of sensation seeking and reward sensitivity are somewhat related, they are essentially two separate traits. For instance, sensation seeking can be defined as an individual's propensity to seek and participate in various types of novel, high arousing experiences, in spite of the risks associated with these experiences (Zuckerman, 1994). Individuals high on sensation seeking are more willing to take risks compared to those individuals lower on this trait. Reward sensitivity refers to one's sensitivity to rewarding stimuli (Gray & McNaughton, 2000), which may or may not be novel or particularly arousing. As previously stated in chapter 2, section 2.2.3, individuals who are more sensitive to rewards are more likely to approach incentive cues compared to those who are less sensitive to rewards (Corr, 2008). In a driving context, young drivers may perceive risky driving behaviours to be associated with rewarding outcomes (e.g., speeding behaviour to impress one's friends may be considered by some young drivers to be a rewarding experience) and thus, may be more inclined to take greater risks while driving.

4.6.1 Sensation seeking

Numerous studies have reported that, compared to young drivers with lower self-reported ratings on sensation seeking scales, young drivers with higher ratings on this trait were more likely to report risky driving behaviours, including speeding behaviour, driving under the influence of alcohol, and driving without a seatbelt (Dahlen & White, 2006; Dahlen, Martin, Ragan, & Kuhlman, 2005; Jonah, Thiessen, & Au-Yeung, 2001; Schwebel, Severson, Ball, & Rizzo, 2006; Trimpop & Kirkcaldy, 1997; Ulleberg & Rundmo, 2003). Ulleberg and Rundmo (2003), for instance, found that in a large Norwegian sample of 16-23 year olds, sensation seeking showed a significant moderate positive relationship with speeding behaviour. Further, Dahlen and White (2006) found that sensation seeking had a significant weak positive relationship with an increased number of both minor and major crashes. This study also found that young male drivers reported higher scores on the sensation seeking scale compared to young female drivers, a gender difference which is commonly reported in the literature (e.g., Dahlen et al., 2005; Santesso et al., 2008; see also: Zuckerman, 1994). Collectively, these findings provide support for the view that higher sensation seeking individuals may be more susceptible to risky driving behaviour, particularly young male drivers.

Using a variety of anti-drug public health communication campaigns (e.g., anti-marijuana, Palmgreen, Stephenson, Everett, Baseheart, & Francies, 2002; Stephenson & Palmgreen, 2001; and anti-cocaine campaigns, Everett & Tacalmgreen, 1995), previous research has reported that individuals high in sensation seeking respond differently to advertisements than individuals lower in sensation seeking. Consistently, this research has found that individuals who report higher sensation seeking scores are more likely to attend to campaigns that are higher in message sensation value (i.e., high arousing/ stimulation messages) compared to campaigns that are lower in message sensation value (i.e., low arousing messages). This body of research indicates that responses to health communication messages may differ depending on an individual's personality disposition and further highlights the need to continue to increase our understanding of how different road safety advertisement strategies, can be designed to target these high risk road users.

4.6.2 Reward sensitivity

More recently, and of particular interest to the current research program, research has examined the relationship between reward sensitivity trait and risky driving behaviours (Constantinou et al., 2011; Harbeck & Glendon, 2013; Scott-Parker et al., 2012, 2013). Similar to the sensation seeking findings described above, research has reported that individuals who are more sensitive to reward are more likely to report engaging in risky driving behaviour compared to those who are less sensitive to rewards (Constantinou et al., 2011; Harbeck & Glendon, 2013; Scott-Parker et al., 2012, 2013). Constantinou et al. (2011) found a small to moderate positive relationship between BAS: Reward Responsiveness (a scale of Carver & White's BAS Scales) and non-aggressive on-road violations, indicating that young drivers who are more sensitive to rewards are more likely to participate in risky driving behaviour compared to those who are less sensitive to rewards. Further, in a recent Australian study, Scott-Parker et al. (2012) reported that young drivers who were more sensitive to rewards reported greater engagement in risky driving behaviours compared to those who were less sensitive to rewards. In summary, research has, thus, established that individual differences, particularly reward sensitivity, may be a factor in risky driving behaviour.

Although numerous studies (e.g., Dahlen & White, 2006; Harbeck & Glendon, 2013) have identified that personality characteristics influence driving behaviour, limited research attention has been given to the examination of individual differences and their influence upon how young drivers process and accept road safety messages. Thus, Study 2 was designed to address this gap in knowledge and examine if individual differences in reward sensitivity (Behavioural Approach System; BAS), along with punishment sensitivity (Fight-Flight-Freeze System; FFFS) influence the processing and subsequent acceptance of gain-framed and loss-framed road safety messages in a young driver population.

Increased understanding of the extent to which these individual difference factors may influence message processing and subsequently, message acceptance, may provide important insight into how to more effectively target high risk drivers through message design. While it is acknowledged that personality traits are stable and hence, unlikely to change, a range of road safety messages could be designed to target these individuals (especially those associated with risky driving). For example, the design and implementation of gain-framed road safety messages may potentially align with those who are more sensitive to rewards, a group already identified in the literature as being at greater risk for unsafe practices. In turn, such alignment may increase the persuasiveness of these messages and more importantly, reduce risky driving behaviour by these road users.

4.7 Chapter Summary

This chapter reviewed the literature on young drivers, specifically highlighting why this age group is more vulnerable to risky taking behaviour, compared to older, more experienced drivers. For instance, compared to older, more experienced drivers, young drivers are more susceptible to road crashes and are more likely to report speeding behaviour. Hence, the current program of research was designed to focus upon young drivers and their speeding behaviour. Next, the perceptual bias literature was discussed, which has suggested that young drivers are susceptible to driving related optimism bias and in relation to the TPE, may be less inclined to follow the recommendations of road safety messages as they perceive that the messages are designed to target other road users. In addition to examining potential RST trait effects on processing and subsequent acceptance of road safety and motor vehicle messages, Study 2 further examined personality effects on risky driving behaviours and perceptual biases (i.e., optimism bias and TPE). Chapter 4 then argued that individuals with stronger sensation seeking and reward sensitive traits (compared to those with weaker traits) may be more likely to participate in risky driving behaviour and hence suggesting that alternative approaches such as gain-framed messages be designed to target these high risk individuals.

Chapter 5. Cognitive Processing

5.1 Chapter overview

This chapter reviews the literature on cognitive processing. First, the chapter presents the literature on spreading activation models and repetition priming, focusing on long-term priming effects. The chapter then provides an overview of the use of Event-Related Potentials (ERPs), focusing on the N100, N200, and P300, and reviews studies that have used these ERPs components to examine the influence of individual differences on processing of emotional images. The chapter concludes by critically reviewing research that has used physiological research methods in an advertising context.

5.2 Spreading activation models

Spreading activation models propose that the neural network for memory consists of semantic nodes that are connected together by pathways (Anderson, 1976, 1983, 1993; Collins & Loftus, 1975; Quillian, 1967). Collins and Loftus's (1975) spreading activation theory of semantic processing and Anderson's (1976, 1983, 1993) Adaptive Control of Thought theory are the two most prominent spreading activation theories. While these models propose different approaches to the underlying concepts of the spreading activation process, both models contend that semantic concepts are represented by nodes and spreading activation occurs when a node activates a semantically related node via its connected pathways. The length of the pathways between the nodes depends on the relationship between the concepts that the nodes represent. For instance, the distance between semantically related nodes is shorter and therefore, concepts that are similar to each other (e.g., bike and helmet) are more likely to be recalled faster after activation than concepts that are unrelated and further apart in the network (e.g., bike and pool). Further, while multiple nodes can be activated at once (e.g., bike may equally activate the nodes that represent 'helmet' and 'cycle' at the same time), the speed of the activation between the related nodes rapidly decreases across time.

Various semantic priming studies have provided consistent support for these models of spreading activation by finding that participants are quicker to respond to a word that had been previously primed by a related word (e.g., Becker, 1980; Bentin, Meyer & Wood, 1985; Foss, 1982; Meyer & Schvaneveldt, 1971; Neely, 1976). Foss (1982), for instance, reported that participants processed words in sentences to a greater extent (as indicated by faster reaction times [RTs]) if they were semantically related to words presented in the previous sentence compared to sentence words that were semantically unrelated. Similarly, Bentin et al. (1985) found that participants demonstrated faster RTs to target words (e.g., rain) when they followed semantically related priming words (e.g., snow) compared to unrelated filler words and non-words.[12] These studies show that semantic priming influences processing of related word stimuli.

5.3 Repetition priming

An additional priming effect that has also been reported to facilitate word recognition and word processing is repetition priming. While semantic priming occurs when the prime word and target word are semantically related (e.g., bike and helmet), repetition priming occurs when both the prime and target words are exactly the same (e.g., bike and bike). Similar to the semantic priming effects, previous research has shown consistently that individuals are quicker to respond to repeated words than to words which have not been repeated (e.g., Bentin & McCarthy, 1994; Dannenbring & Briand, 1982; Forster & Davis, 1984; Kim, Kim, & Kwon, 2001; Scarborough, Cortese, & Scarborough, 1977). This repetition priming effect has been evident both in the short-term (i.e., the target word presented immediately following the prime; e.g., Bentin & McCarthy, 1994) as well as long-

[12] No examples of the filler words and non-words are provided in Bentin et al. (1985).

term contexts (i.e., a delay of up to two days between presentation of the prime and target words; e.g., Scarborough et al., 1977). Given that Study 2 used long-term priming (i.e., a delay of up to four minutes) to assess message processing, the following section focuses particularly upon research which has examined long-term word repetition effects (for some relevant studies based on short-term word repetition effects, see, for example, Bentin & McCarthy, 1994; Humphreys, Besner, & Quinlan, 1988; Méndez-Bértolo, Pozo, & Hinojosa, 2011).

Using a lexical decision task (LDT), Dannenbring and Briand (1982) manipulated the number of trials (i.e., 0, 1, 5, and 16) between when participants were exposed to the word primes and the target words which repeated (i.e., were the same as) the primes. Participants were required to respond as quickly and as accurately as possible as to whether a presented letter string represented a word or a pseudoword (i.e., pronounceable non-word). The findings revealed that participants were quicker to respond to target words if they had been previously presented, regardless of the number of trials that separated the prime and repeated target word. Similarly, earlier research by Scarborough et al. (1977) reported that the long-term word repetition effects (assessed via a LDT) were also evident several days after presentation of the original word stimulus. Thus, evidence suggests that both short-lags (i.e., seconds/ minutes) and long-lags (i.e., up to a couple of days later) can result in word repetition effects.

More recent research has also provided support for long-term word repetition effects (e.g., Albrecht & Vorberg, 2010; Lowder, Choi, & Gordon, 2013). Lowder et al. (2013), for instance, exposed participants to a series of short sentences, each including several names of people that were used as the prime and target stimuli. The names were either presented once in the sentence (e.g., Joseph, Justin, and Phillip) or the same name was presented twice in the sentence (e.g., Joseph, Justin, and Joseph, the second presentation of the name was presented a few seconds after initial presentation). In support of long-term repetition effects, the findings revealed that participants were quicker to process names which had previously been presented compared to names which had only been presented once in the sentence. In Lowder et al. (2013), processing was assessed via eye tracking. Further, Albrecht and Vorberg (2010) found that exposing participants to word stimuli for as little as 54ms, resulted in long-term word repetition effects in a later word/ non-word LDT. Specifically, participants were quicker to respond to words in the LDT if they had been previously viewed by the participants.

Collectively, the findings of Albrecht and Vorberg (2010), Dannenbing and Briand (1982), Lowder et al. (2013), and Scarborough et al. (1977) support repetition priming effects by highlighting that individuals are quicker to respond to words which have been previously presented compared to words which are not repeated, across a range of time-frames and different contexts. Thus, there is evidence to suggest that if an individual processes the prime word on initial presentation, faster RTs should occur on the second presentation of the word.

Since the LDT has been incorporated to assess long-term word repetition priming effects (e,g., Albrecht & Vorberg, 2010; Dannenbring & Briand, 1982; Scarborough et al., 1977) and has been shown to be a reliable and valid measure of assessing memory, attention, and information processing (see Tenpenny, 1995) it was included in the current program of research to assess message processing.[13] Specifically, the LDT was included in Study 2 as a measure of processing bias towards the words contained in the previously presented text-only gain-framed and loss-framed anti-speeding messages in Study 2 (see Chapter 7). However, while the LDT has been used frequently to measure word processing, ERPs have been applied more recently to examine differences in emotional picture processing (see Olofsson, Nordin, Sequeira, & Polich, 2008). Given that Study 3b included picture stimuli instead of word stimuli, ERPs were used to assess individual differences in processing of positive and negative road safety picture stimuli (see Chapter 8). To the extent that previous research

[13] Chapter 7, section 7.2.2, describes the LDT in more detail.

based on anti-smoking campaigns has found processing differences between text-only and visual message stimuli (see Chapter 3, Section 3.5.1) it is important for research to not only understand more about the processing effects of both text-only and visual message stimuli, but to do so in regards to other health communication areas, such as road safety messages.

5.4 Event-Related Potentials

To expand upon Study 2, Study 3b measured individual differences in processing (via ERPs) of positive and negative road safety pictures. ERPs provide a high temporal resolution method that can be used to assess differences in participants' neural processing of word and picture stimuli and, consequently are a more sensitive measure of cognitive processing (Picton et al., 2000). ERPs are averaged electroencephalography (EEG) evoked potentials, measured from a person's scalp, that are time locked to a particular event (e.g., onset of a visual stimulus; Duncan et al., 2009). Thus, ERPs allow researchers to examine neural responses at the same time as the events are occurring. ERPs are extracted from the EEG data using a process referred to as the signal-averaging technique to reduce the noise and obtain the required ERP components (Picton et al., 2000). ERPs can differ in terms of latency (i.e., peak of wave), polarity (i.e., negative wave or positive wave), and scalp distribution (Sanei & Chambers, 2008). Study 3b focused on three ERPs: an early negative potential (N100), a middle negative potential (N200), and a late positive potential (LPP; P300), measured along the anterior-posterior midline (i.e., frontal (Fz), central (Cz), parietal (Pz), and occipital (Oz) locations). These ERPs responses have been related to individuals attending to, and processing, emotional picture stimuli in the general population (e.g., Polich & Kok, 1995; Kok, 1997).

5.4.1. Negative potentials: N100 and N200

The N100 are N200 are negative components that typically peak between 70-160ms and 200-300ms after visual stimulus onset, respectively (Luck, 2005; Olofsson et al., 2008).

The N100 and N200 components have been associated with pre-attentional processes towards visual emotional stimuli (e.g., Coull, 1998), with a more pronounced N100 and N200 observed when individuals attend to these emotional visual images. The N100 and N200 responses have been reported to be more pronounced over the frontal and central neural regions in adolescents and young adults (e.g., De Pascalis et al., 1996; Freidman, Brown, Vaughan, Cornblatt, & Erlenmeyer-Kimling, 1984).

5.4.2 Late positive potential: P300

The P300 is a large positive component that is typically measured at three electrode sites (i.e., Fz, Cz, and Pz) along the anterior-posterior midline and peaks approximately 300-500ms after stimulus onset (see Duncan et al., 2009). Studies examining the P300 response have reported that this response is elicited on presentation of meaningful stimuli and, thus, is thought to reflect information processing (i.e., larger P300 amplitudes indicate stronger processing; e.g., Kok, 1997). Similar to the N100 and N200, the P300 is typically more pronounced over the central and parietal neural regions (Johnson, 1993).

The N100, N200 and P300 components have been used to assess attention and/ or processing of different emotional stimuli, for example, emotional words (e.g., Bartussek, Becker, Diedrich, Naumann, & Maier, 1996), auditory stimuli (e.g., Morita, Morita, Yamamoto, Waseda, & Maeda, 2001), and visual stimuli (e.g., Cano, Class, & Polich, 2009; Hajack & Olvet, 2008; Liu et al., 2012). However, since the current program of research has examined participants' reactions towards a range of negative and positive images drawn from past road safety television campaigns, the focus of the next section of this literature review reviews ERP studies that have used visual stimuli in particular to assess individuals' reactions towards negative and positive emotional images, as a function of the BAS and the FFFS traits.[14]

5.5 Personality and processing visual image stimuli

Various studies have used ERPs to examine the influence of individual differences on the processing of visual emotional words and picture stimuli (e.g., Balconi, Falbo, & Conte, 2012; Bartussk, et al., 1996; De Pascalis et al., 1996, 2004; Gable & Harmon-Jones, 2013; Yuan, He, Lei, Yang, & Li, 2009). Bartussk et al. (1996), for instance, devised a processing task whereby young adults were required to make decisions about emotional adjectives. Providing mixed support for Gray's original RST, Bartussk and colleagues found that at the Fz site, individuals high on introversion elicited larger P300 (indicating greater word processing) to negative words compared to positive words. In contrast, individuals high on extraversion demonstrated greater processing of both the negative and positive word stimuli. This latter finding is inconsistent with theoretical predictions of Gray's original RST, which would have predicted that individuals high on the extraversion trait should have elicited larger P300 to only positive word stimuli when compared to negative word stimuli.

De Pascalis et al. (1996) designed two computerised visual recognition tasks whereby participants were required to judge if a series of letter strings were words or non-words. Both tasks consisted of either reward or punishment feedback, depending on the participant's response. For instance, participants who responded correctly to the letter strings received a visual feedback of cue of 'correct' in task 1 and 500 Italian Lire and a visual feedback of cue of 'winning' in task 2. Incorrect responses received visual feedback of cue of 'incorrect' (task 1) and a deduction of 500 Lire and visual feedback cue of 'losing' (task 2). Providing support for Gray and McNaughton's revised RST, individuals who were sensitive to rewards elicited

[14] Whilst it is beyond the scope of this dissertation to review ERPs and auditory stimuli, interested readers should refer to previous reviews (e.g., Bendixen, SanMiguel, & Schröger, 2012).

larger P600s[15] when presented with the visual ‘winning’ feedback cue, while individuals who were less sensitive to reward elicited lower P600s when exposed to the visual ‘losing’ feedback cue.

More recently, De Pascalis, Strippoli, Riccardi, and Vergari (2004) used an oddball paradigm[16] to assess the relationship between Gray’s original RST traits and positive and negative valenced words. Individuals who reported higher anxiety scores on the State-Trait Anxiety Inventory Form Y2, compared to those who reported lower anxiety scores, elicited greater P300 amplitudes at the frontal and temporal neural regions towards negative words, suggesting greater processing of these negative words. Further, compared to individuals with lower impulsivity scores, those individuals who reported higher impulsivity scores showed less processing of the negative words (i.e., lower P300 amplitudes) at the parietal and occipital brain regions. While no significant relationships were reported between positive word processing and personality traits, these findings provided some support for Gray and McNaughton’s RST predictions, suggesting that individuals with a strong FFFS are more sensitive to, and process to a greater extent, cues of punishment.

Using picture stimuli sourced from the IAPS, Balconi et al. (2012) found that those individuals who reported a stronger BAS showed greater processing (i.e., higher P300 amplitudes) towards positive pictures compared to negative or neutral images, while individuals with a stronger Behavioural Inhibition System (BIS), showed greater processing of the negative images than positive or neutral pictures. Similarly, using the Chinese Affective Picture System, Yuan et al. (2009) found that individuals high on extraversion elicited larger P300 amplitudes to positive pictures compared to neutral images, indicating greater processing of the positive picture stimuli. In contrast, Gable and Harmon-Jones

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[15] The P600 is a language related component which is thought to reflect syntactic violations (Núñez-Peña & Honrubia-Serrano, 2004).

[16] Chapter 8, section 8.2.2, describes the oddball paradigm task in more detail.

(2013) reported no significant relationships between Gray's original RST traits and the P300 response on presentation of positive (i.e., images of desserts) and neutral (i.e., images of rocks) stimuli. However, Gable and Harmon-Jones (2013) found that individuals with a stronger BAS showed greater N100 amplitudes to positive pictures compared to those individuals with a weaker BAS, indicating an earlier onset of pre-attentional processes. While these findings provide some support for Gray and McNaughton's (2000) prediction that individuals who have a stronger BAS are more sensitive to reward cues and individuals with a stronger FFFS are more sensitive to punishment cues, the findings may also highlight that neural processing of visual reward stimuli may start to occur earlier at N100 instead of P300.

Although previous research has provided support for the relationship between visual image processing and RST traits, research evidence to date has yet to apply this knowledge to the health communication field. To address this gap in the literature, the current program of research (in Study 3) used picture stimuli selected from road safety advertising campaigns developed by the Transport Accident Commission (TAC) of Victoria. The research examined if individual differences in Gray and McNaughton's BAS and FFFS traits influenced individuals processing of these emotional images. By assessing neural processing of images from previously televised road safety advertisements, this phase of the research program was designed to increase understanding of the influence of BAS and FFFS traits on message processing and potentially message effectiveness.

5.6 Physiological measures in advertising research

5.6.1 Skin conductance responses and advertisements

While physiological measures have been previously used to assess promotional commercial marketing campaigns (e.g., Ohme, Reykowska, Wiener, & Choromanska, 2010b), these measures are less commonly used to assess road safety advertisements. However, one physiological measure which has recently been applied to measure emotional reactions towards emotional road safety advertisements is the skin conductance response (SCR). SCR is a physiological measure assumed to reflect both positive and negative emotional arousal (Boucsein et al., 2012). To measure SCR, electrodes are attached to the palm of an individual's hand or alternatively, on the tips of two fingers to measure arousal responses from the sweat glands.

One SCR study in a road safety advertising context found that SCR differed depending on the type of advertisement (Thornton, 2005). Thornton (2005) recruited 160 participants to view one of eight road safety advertisements. Of those advertisements, four were fear-only advertisements and four were fear-relief advertisements. The findings indicated that arousal levels differed depending on the content of the advertisement. Specifically, when the initial shock of the advertisement was presented on screen (e.g., vehicle hitting a pedestrian) there was an increase in the arousal felt by the participants compared to their earlier arousal recordings at the beginning of the advertisement.

While the SCR can provide researchers with the precise moments that arousal occurs throughout one's exposure to an advertisement, this physiological measure cannot provide information on the persuasiveness of the advertisement (Algie & Rossiter, 2004). Thus, more sensitive physiological measures of cognitive processes (beyond arousal), such as ERPs, are required to assess message processing and subsequent, message persuasiveness. To date, no published studies have applied neurological methods, such as ERPs, to examine processing of road safety messages. Therefore, the following section draws upon research in the health communication field that has applied neurological measures to assess processing and subsequent acceptance of health communication messages.

5.6.2 ERP and functional Magnetic Resonance Imaging (fMRI) and advertisements

Only recently have researchers started to apply neuroimaging measures to examine brain activity in response to advertisement exposure. While an array of marketing studies have used EEG to observe differences in neural activity towards television commercials that promote product brands (e.g., Astolfi et al., 2008a,b; Ohme, Matukin, & Szczurko, 2010a; Ohme, et al., 2009, 2010b; Vecchiato et al., 2010a,b), fewer studies have used ERPs or fMRI (a spatial resolution method whereby participants view stimuli whilst brain images are recorded) to examine processing of health communication messages (for exceptions see Chua, Liberzon, Welsh, & Strecher, 2009a; Chua, Polk, Welsh, Liberzon, & Strecher, 2009b; Falk, Berkman, Mann, Harrison, Lieberman, 2010; Falk, Berkman, Whalen, & Lieberman, 2011; Kessels, Ruiter, Brug, & Jansma, 2011; Kessels, Ruiter, & Jansma, 2010; Ruiter, Kessels, Jansma, & Brug, 2006).

Ruiter et al. (2006), for instance, designed a dual-paradigm task to assess if message tailoring influenced attention and processing towards the messages. In this task, individuals were exposed to auditory stimuli while reading either a tailored (i.e., high personal relevance) or non-tailored (i.e., low personal relevance) nutrition education message. The findings revealed that individuals who viewed the non-tailored message demonstrated greater attention towards the auditory stimuli (as indicated by larger P300 amplitudes) compared to individuals who viewed the tailored message who in turn, assigned greater attention towards the message. These findings are not only consistent with previous self-report findings that highlight the importance of message segmentation (e.g., Maheswaran & Meyers-Levy, 1990, Millar & Millar, 2000; see also: Kreuter & Wray, 2003), but also emphasises the utility of ERP methods for assessing message attention and/ or processing.

Similar to Ruiter et al. (2006), Kessels et al. (2011) devised an auditory dual-paradigm ERP study to further assess individuals’ attentive processes towards tailored and non-tailored nutrition messages. Kessels and colleagues reported that individuals demonstrated greater attentive processes (measured by the P300 response) towards the tailored compared to the non-tailored nutrition messages. However, in contrast to the ERP results, participant self-report ratings revealed that the participants perceived no differences in their attention towards the two different message conditions. These findings reveal the potential discrepancies between measures of self-report and objective physiological measures of advertisement effects and highlight the superior sensitivity of objective measures for assessing the extent of message processing.

Similar to ERP studies of message attention and message processing, fMRI studies of message processing and message acceptance have emphasised the importance of using psychophysiological measures alongside traditional measures of self-report. For instance, Falk and colleagues (2010, 2011) conducted two studies, one which exposed participants to sun safety images (presented as print) while the other study exposed participants to anti-smoking messages (presented as televised public service announcements). The findings revealed that neural activity (as assessed via fMRI) could explain an additional 23% and 20% of the variance in actual behaviour change that was unaccounted for by indirect measures of message acceptance for the sun safety print images and the anti-smoking television messages, respectively. Further, both studies found that participants who showed greater activity in the mesial prefrontal cortex and the precuneus brain regions (brain areas associated with information processing; see reviews, Cavanna & Trimble, 2006; Etkin, Egner, & Kalisch, 2011) when viewing the stimuli were more likely to change their behaviour in line with the message.

Similar findings were also reported by Chua et al. (2009a). Using fMRI to assess message processing, participants were exposed to a tailored and non-tailored anti-smoking message, presented as an audio (radio-type) message. The findings revealed that when participants were exposed to the tailored message (compared to the non-tailored message), the rostal mesial prefrontal cortex and precuneous/ posterior were activated, indicating greater message processing. Thus, both Falk et al. (2010, 2011) and Chua et al. (2009a) highlight the added benefits that brain imaging methods can offer in increasing understanding of the underlying neural processes involved in message processing and subsequent message acceptance.

Applying physiological measures, such as ERPs to assess participants' reactions to health messages is not well understood and further research is required in the health advertising field (Elliott, 2011). Based on previous ERP and fMRI findings that have examined health communication messages (e.g., Falk, 2010, 2011; Kessels et al., 2011), applying these measures in a road safety advertising context may lead to more reliable results, which can infer campaign designers in targeting high risk drivers, such as young adults. While ERPs and fMRIs have been used to assess anti-smoking, sun safety, and nutrition-related health communication messages, the current program of research is the first to use ERPs to assess message processing relating to road safety messages.

5.7 Chapter Summary

Chapter 5 reviewed the relevant literature on cognitive processing. Specifically, this chapter highlighted the utility of incorporating more objective measures, such as cognitive reaction-time based tasks (e.g., LDT) and neural processing measures (e.g., ERPs), to further understand the role of individual differences in the BAS and the FFFS traits in influencing message processing. This chapter reviewed previous research which has applied these measures in other health communication contexts (e.g., ERPs to further examine processing of nutrition education campaigns) and argued the benefits of applying these objective measures in the current program of research to further understand processing of road safety messages. To the best of the candidate's knowledge, the current program of research has been the first to examine message processing via ERPs in a road safety advertising context and consequently, may provide important insights into how road safety advertisements may be informed by using more objective measures to further understand how young drivers process these campaigns.

Chapter 6. Study 1: Message Piloting and Manipulation Checks

6.1 Chapter Overview

This chapter presents the first three studies (i.e., Studies 1a, 1b, and 1c) of the research program and is divided into five sections. The first section provides an introduction to the overall purpose of Study 1, before presenting the aims and details of the development of the messages and word stimuli devised for the lexical decision task (LDT) in Study 2. Subsequent sections present Study 1a: Evaluation of the road safety messages, Study 1b: Evaluation of the motor vehicle message and Study 1c that qualitatively explored individuals' responses to the messages. The chapter concludes with a general discussion of the Study 1 findings.

6.2 Introduction

The overall purpose of Study 1 was to pilot and refine the final road safety messages and the promotional motor vehicle message to be used in Study 2 to activate the Reinforcement Sensitivity Theory (RST) traits. Stimuli checks are necessary to ensure that the stimuli are designed to activate the desired RST traits. As stated by Corr (2013), it is not suitable to assume that punishment stimuli will activate the Fight-Flight-Freeze System (FFFS) and that reward stimuli will activate the Behavioural Approach System (BAS), based only on the theoretical assumptions of the RST. As such, a small sample of young drivers were recruited in the various phases (a, b, c) of Study 1 to assess the extent to which the two gain-framed messages (designed to activate the BAS), the two loss-framed messages (designed to activate the FFFS), and the motor vehicle message (designed to activate the BAS and Behavioural Inhibition System (BIS) when paired with the social loss-framed message), activated the intended and appropriate system. Manipulation checks also reduce the likelihood that potential confounds may influence the findings of an experimental design (Perdue & Summers, 1986), provide researchers with greater control over the experimental variables, and increase the reliability of the research findings (Laczniak, Muehling, & Grossbart, 1989).

6.2.1 Sample characteristics

Chapter 4 highlighted that young road users aged between 17 and 25 years are particularly susceptible to driving related fatalities. Representing only 13% of the total driving population, young drivers account for over 20% of all driving fatalities on Australian roads (BITRE, 2013). Risk taking behaviour, such as speeding behaviour, is one factor that has been identified to increase driving related fatalities among this age group. It is therefore important to ensure the development of effective countermeasures such as, persuasive health communication messages, to encourage safer driving behaviours of young adults. Studies 1a-c and 2 include four purpose designed anti-speeding road safety messages to assess young drivers' message processing and subsequent message acceptance (see Section 6.4).

In this research, all participants were required to hold a current Australian driver's licence. Therefore, it was presumed, that on any given driving occasion, participants would have the opportunity to engage in speeding behaviour and/ or indirectly experience speeding behaviour as the result of other motorists. Consequently, there is some degree of involvement that could be expected for most individuals with a behaviour such as speeding, which research indicates is the most commonly engaged in driver violation. Thus, it was presumed that anti-speeding messages would be relevant to these samples of young drivers, to the extent that speeding represents a common violation in the general public and remains largely accepted in Australian society (Fleiter & Watson, 2006; see chapter 4).

6.2.2 Arousal and valence

Word arousal and valence properties have been reported to influence reaction time (RT) data (Aquino & Arnell, 2007; Kousta, Vinson, & Vigliocco, 2009). Aquino and Arnell (2007), for instance, reported that neutral words (i.e., lower arousal words) resulted in faster

RTs than sexual words (i.e., higher arousal words), indicating that participants directed more attention to the high arousing words compared to the low arousing words. In terms of valence, previous research has found that positive and negative words are processed faster than neutral words (e.g., Kousta et al., 2009; Schacht & Sommer, 2009; Scott, O'Donnell, Leuthold, & Sereno, 2009). However, while this finding is consistent across various studies, there are inconsistent findings regarding the processing speed for positive compared to negative words. For example, while some studies have reported that positive words were processed faster than negative words (e.g., Kuchinke, Jacobs, Grubich, Conrad, & Herrmann, 2005), other studies have found the opposite effect (e.g., De Houwer & Hermans, 1994). Further, some studies have reported no significant differences in individuals' RTs to positive and negative word stimuli (Kousta et al., 2009; Scott et al., 2009). Studies 1a and 1b, therefore, included self-report word rating measures of arousal and valence to control for the potential confound that word arousal and/ or valence effects could have on the reaction data from the LDT. By controlling for word arousal and word valence ratings between the messages in Studies 1a and 1b, findings from Study 2 can be interpreted as reflecting differences in Gray and McNaughton's RST traits rather than differences in emotional content (word arousal and valence) between the message conditions.

Data were collected using both quantitative and qualitative research methods. Quantitative approaches (i.e., descriptives and *t*-tests) were applied in Studies 1a and 1b to examine the validity of the framing manipulations (gain-framed vs. loss-framed messages), the credibility of the motor vehicle message (i.e., if participants perceived that the motor vehicle message was believable), and the emotional valence and arousal properties of the individual word stimuli. A qualitative approach was then undertaken in Study 1c, whereby focus groups and individual interviews were conducted to further examine individuals' responses to the road safety and vehicle messages. Incorporating both quantitative and qualitative approaches facilitated an in-depth evaluation of the devised road safety and motor vehicle messages stimuli.

6.3 Research aims

The aims of Study 1a were two-fold. First, Study 1a aimed to assess the validity of manipulation of message frames. To ensure that the road safety messages were interpreted as intended (i.e., gain-framed messages included gain/ reward cues and the loss-framed messages included loss/ punishment cues) a 7-point semantic differential scale using the following word pairs: disadvantage/ advantage, negative/ positive, and loss/ gain (Shen & Dillard, 2007). The second aim was to assess the arousal and valence ratings of the individual words in the physical and social road safety messages (which would form the LDT stimuli in Study 2). To reduce any potential confounds that emotional words may have on participants' processing of the road safety messages, two 7-point semantic differential scales (1 = *low arousal*, 7 = *high arousal*; Aquino & Arnell, 2007 and 1 = *negative*, 7 = *positive*) were used to assess word arousal and word valence, respectively.

The aims of Study 1b also were two-fold. First, Study 1b aimed to assess the credibility of the motor vehicle message devised for this study. The motor vehicle message was intentionally designed to promote a high performance vehicle and implied risky driving, such as high speeds (compared to those safer behaviours advocated in the road safety messages). Participants rated the credibility of the motor vehicle message on a 7-point semantic differential scale (1 = *unbelievabl*e, 7 = *believable*; MacKenzie & Lutz, 1989). The second aim was to assess the arousal and valence of the individual words in the motor vehicle message.

Study 1c explored further young drivers' thoughts and feelings towards the road safety and motor vehicle messages via qualitative methods. Qualitative analysis was undertaken to extend upon on the self-reported responses regarding message frame (Study 1a) and advertisement credibility (Study 1b).

6.4 Message and word stimuli

6.4.1 Development of the road safety messages

The four road safety messages (i.e., physical gain-framed, physical loss-framed, social gain-framed and social loss-framed) were taken from Kaye et al. (2013). To ensure that the messages were age-appropriate (i.e., suitable for drivers from the 17 to 25 year old population), they were piloted on a younger sample of participants in Studies 1a-c than in Kaye et al. (2013). Further, while the messages functioned as intended in Kaye et al. (2013), the social messages were longer than the physical messages and may have potentially lead to memory load and/ or word confounds. Accordingly, an additional sentence was added to the physical messages (i.e., “Driving under/ over the posted speed limit decreases/ increases the severity of physical injuries you and your passengers may sustain in the event of a crash”) to control for length between the two message types. The gain-framed messages were designed to activate the BAS, while the loss-framed messages were designed to activate the FFFS, which prior research supported (Kaye et al., 2013; see Table 6.1 for the message stimuli used in this program of research).

Table 6.1

Initial Version of the Road Safety and Motor Vehicle Messages as Presented to Participants in Studies 1a, 1b, and 1c

Physical loss-framed message

Each year in Australia, approximately 400 people will ***die*** if drivers ***do not*** obey the speed limits

By ***not*** obeying the speed limits, you are ***increasing*** your risk of crashing and ***not*** protecting yourself and your loved ones

Driving ***over*** the posted speed limit ***increases*** the severity of physical injuries you and your passengers may sustain in the event of a crash

Slow down, monitor your speed

Physical gain-framed message

Each year in Australia, approximately 400 people will ***be saved*** if drivers ***were to*** obey the speed limits

By obeying the speed limits, you are ***decreasing*** your risk of crashing and protecting yourself and your loved ones

Driving ***under*** the posted speed limit ***decreases*** the severity of physical injuries you and your passengers may sustain in the event of a crash

Slow down, monitor your speed

Social loss-framed message

When you choose to speed with your friends in the car, you're showing them that you really ***don't*** care about their safety

Although they probably won't say it, your friends will feel ***less*** comfortable and ***less*** confident with you as a driver when you ***do*** speed

By speeding, you're ***not*** putting your friends' safety first and ***not*** being the best friend you can be

Slow down, monitor your speed

Social gain-framed message

When you choose ***not*** to speed with your friends in the car, you're showing them that you really ***do*** care about their safety

Although they probably won't say it, your friends will feel ***more*** comfortable and ***more*** confident with you as a driver when you ***don't*** speed

By ***not*** speeding, you're putting your friends' safety first and being the best friend you can be

Slow down, monitor your speed

Motor vehicle message

This high performance sports model can achieve 0 to 100 km/h in 6 seconds and exceeds 200 km/h in 11.8 seconds

This vehicle is powered by a turbo V8 engine and reaches a top speed of 290kms/per hour

The Extreme Xx sports model is one of the fastest street legal vehicles permitted on Australian roads

You will be the envy of all your mates if you test drive one today

Note. Differences between the gain-framed and loss-framed messages are highlighted in bold.

6.4.2 Development of the motor vehicle message

The motor vehicle message was developed in the current research with the intent to activate the BIS (when paired with the conflicting goals of the social loss-framed message) in Study 2 and, as such, was devised specifically to highlight the high speed capabilities of a high performance vehicle (see Table 6.1). As discussed in chapter 2, activation of the BIS is theorised to occur when individuals are exposed to conflicting cues, such as both FFFS/ punishment cues (e.g., social loss-framed message that emphasises the negative consequences of speeding behaviour) and BAS/ reward cues (e.g., a motor vehicle message that promotes a vehicle designed to reach high speeds). The motor vehicle message was piloted for its suitability in Study 1b to test and control for potential word confounds (e.g., valence and arousal differences) between the word stimuli used in the motor vehicle message and the word stimuli used in the social loss-framed message that could influence individuals' reactions towards these messages. Further, in Studies 1b and 1c, the motor vehicle message was examined in its entirety to assess the relevance and believability of this message.

6.4.3 Word stimuli selection

In Study 2, a word/ non-word lexical decision task (LDT)[17] was used to assess message processing. While a large number of studies have used the LDT to assess RT to word stimuli (e.g., Borkenau, Paelecke, & Yu, 2010; Christopherson & Ferraro, 2009; Noguera, Ortells, Abad, Carmona, & Daza, 2007), past research has shown that RTs to words can be influenced by a number of factors. These factors include, for example, word frequency (i.e., faster RTs occur for more frequent than less frequent words; Scarborough et al., 1977), word length (i.e., shorter words result in faster RTs than longer words; New, Ferrand, Pallier, & Brysbaert, 2006), concreteness or abstractness of the words (i.e., concrete words are identified faster than abstract words; Kroll & Merves, 1986), and word type (i.e., faster RTs occur for nouns than verbs; Gomes, Ritter, Tartter, Vaughan Jr., & Rosen, 1997). These factors represent potential confounds of studies of word and/ or sentence processing, and were therefore assessed in Studies 1a and 1b.

The $\text{SUBTLEX}_{\text{US}}$ lexical corpus was used to control for word frequencies in the initial selection of the words used in the physical messages, social messages, and motor vehicle message (Brysbaert & New, 2009). An independent groups *t*-test revealed that there were no significant differences between the physical and social word frequencies, $t(24) = 0.14$, $p = .891$, 95% CI [-513.05, 587.22], nor between the social and motor vehicle message word

[17] Chapter 7, section 7.2.2, provides further information on the LDT used in Study 2.

frequencies, $t(24) = -0.16$, $p = .878$, 95% CI [-907.31, 780.11].[18] As required, similar word frequencies were obtained for the message words lists. To control for word type, each word list consisted of 13 words and included an equal number of nouns, adjectives, and verbs. Further, each word list contained a similar number of concrete and abstract words and ranged from three to 11 letters.[19]

For the purpose of Studies 1a and 1b, two to three filler words were selected for each message word. Filler words were matched to the message words on word frequencies, word length, number of syllables, and word type. Further, to prevent the filler words from confounding the study's results, the filler words were different to those words which were presented within the message stimuli. In Studies 1a and 1b, participants were asked to rate the arousal and valence of both the message words and filler words. The filler words that best matched the message words in terms of the participants' mean arousal and valence ratings were retained for the lexical decision task (LDT) in Study 2.

[18] As the motor vehicle message was only paired with the social loss-frame message to assess the BIS in Study 2, words from the motor vehicle message were not compared with those words from the physical messages.

[19] Mean word lengths were comparable between list types.

Study 1a: Evaluation of the four road safety messages

6.5 Method

6.5.1 Participants

Undergraduate students (n = 41) and young adults from the local community (n = 11) were recruited via email and online advertisements.[20] Selection criteria included being between 17 and 25 years of age and holding a current provisional or open Australian driver's licence.[21] One participant was excluded for not meeting the age criterion. Of the remaining 51 participants (42 female, *M*age = 20.19, *SD* = 2.75), 21 held an open licence and 30 held a provisional restricted licence. Forty-nine participants listed English as their first language. Twenty-nine (56.9%) reported regularly driving over the posted speed limit. The undergraduate participants were offered partial course credit for their time (i.e., 0.5% of credit), while participants recruited from the local community were offered entry into a draw to receive one of two AUD$50 shopping gift cards.

6.5.2 Design

A mixed design was used with participants assigned to view either the two physical messages (i.e., physical gain-framed and loss-framed) or the two social messages (i.e., social gain-framed and loss-framed) to minimise relative judgements. Twenty-four participants viewed the physical anti-speeding messages and 27 participants viewed the social anti-speeding messages. Independent groups and paired *t*-tests assessed message manipulation checks and participants' valence and arousal ratings of the word stimuli.

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[20] For Studies 1a-c, recruitment emails were sent out to QUT student and staff mailing lists. Online advertisements were displayed on the author's Facebook page, QUT Blackboard course sites, and QUT's School of Psychology and Counselling online recruitment system for first year psychology students.

[21] A provisional drivers' licence is received upon passing a driving test. Young drivers are eligible for an open drivers' licence after holding a provisional licence for two years.

6.5.3 Materials and Procedure

Participants were randomly assigned to complete one of two online self-report questionnaires (i.e., containing either the physical messages or social messages), with each version taking approximately 10 minutes to complete. First, participants were asked to answer questions that related to their demographic information (e.g., age and gender), driving history (e.g., type of drivers' license), and current on-road speeding behaviour. Participants were then required to read two messages (i.e., one gain-framed and one loss-framed message) and rate, after each message, the extent to which they perceived the message to be a gain-framed message or a loss-framed message via three 7-point semantic differential scales using the following word pairs: disadvantage/ advantage, negative/ positive, and loss/ gain (Shen & Dillard, 2007). Finally, also using a 7-point semantic differential scale, participants were asked to rate the arousal (1 = *low arousal*, 7 = *high arousal*; Aquino & Arnell, 2007) and valence (1 = *negative*, 7 = *positive*) of the individual message words and filler words.

6.6 Results

The analyses examined the extent to which the gain-framed messages (i.e., physical and social gain-framed) and the loss-framed messages (i.e., physical and social loss-framed) were perceived to include reward and punishment cues, respectively. Results relating to the preliminary checks are presented first, followed by the three key analyses relating to message frame, word arousal ratings (message words and filler word stimuli), and word valence ratings (message words and filler word stimuli) to assess the manipulations of the anti-speeding message stimuli. Paired *t*-tests were used to examine message manipulations, while independent groups *t*-tests were used to assess mean word arousal and valence ratings.

6.6.1 Preliminary checks

Missing data and assumption checks. There were no missing data. All relevant assumptions were met, unless otherwise stated here.

Baseline group checks. To assess if pre-existing group differences existed between the participants who viewed the physical messages and the participants who viewed the social messages, a series of chi-square frequency tests and an independent groups *t*-test were undertaken. The results showed that there were no significant differences between the groups on gender, χ^2 (1) = 0.86, p = 1.00, type of driver's licence, χ^2 (1) = .062, p = .060, or self-reported speeding behaviour, χ^2 (1) = 0.71, p = .782, indicating no significant pre-existing group differences on these three demographic variables. However, the independent groups *t*-test revealed that participants who viewed the physical messages (*M* = 21.26, *SD* = 2.88) were, on average, two years older than those participants who viewed the social messages (*M* = 19.24, *SD* = 2.29), $t(49) = 2.79$, $p = .008$, 95% CI [0.56, 3.47]. Since all of the participants were between 17 to 25 years of age and still constituted young drivers in accordance with government and statistical category purposes, it was believed that this minor difference in mean age between the two message conditions was deemed unlikely to confound the current study's findings and no participants were excluded based on age.

6.6.2 Message word manipulation checks

Paired *t*-tests were performed on participants' mean ratings to assess the manipulation of the message frames (i.e., gain-framed vs. loss-framed messages). The results showed that, as anticipated, the participants who viewed the physical messages were significantly more likely to rate the gain-framed message in the advantage (*M* = 5.38, *SD* = 1.58), $t(23) = 7.10$, p < . 001, 95% CI [2.22, 4.03], positive (*M* = 5.50, *SD* = 1.72), $t(23) = 7.36$, $p < .001$, 95% CI [2.49, 4.43], and gain frame (*M* = 5.42, *SD* = 1.72), $t(23) = 5.99$, $p < .001$, 95% CI [2.15, 4.43], and the physical loss-framed message in the disadvantage (*M* = 2.25, *SD* = 1.19), negative (*M* = 2.04, *SD* = 1.27) and loss frame (*M* = 2.13, *SD* = 1.45). Similarly, the participants who viewed the social messages were significantly more likely to rate the social gain-framed message in the advantage (*M* = 5.59, *SD* = 1.31), $t(26) = 3.29$, $p = .003$, 95% CI

[0.56, 2.41], positive (*M* = 5.56, *SD* = 1.45), *t*(26) = 4.58, *p* < .001, 95% CI [1.20, 3.17], and gain frame (*M* = 5.56, *SD* = 1.45), *t*(26) = 3.55, *p* = .001, 95% CI [0.66, 2.46] compared to the social loss-framed message. However, the social loss-framed message was rated, on average, at the midpoint of the disadvantage/ advantage scale (*M* = 4.11, *SD* = 1.63), negative/ positive scale (*M* = 3.37, *SD* = 1.90), and loss/ gain scale (*M* = 4.00, *SD* = 1.86). These findings suggest that although participants perceived the physical and social gain-framed and physical loss-framed anti-speeding messages as had been intended, the social loss-framed message was rated more neutral rather than in the disadvantage, negative, or loss frame.

6.6.3 Word arousal rating

Message words. An independent groups *t*-test was used to assess if the words in the physical messages differed from the words in the social messages in arousal (i.e., low vs. high) ratings. The results revealed that there were no significant differences in word arousal ratings between the physical message (*M* = 3.06, *SD* = 1.11) and social message lists (*M* = 3.78, *SD* = 0.92), *t*(24) = -1.70, *p* = .085, 95% CI [-1.54, 1.06], η^2 = .07. Thus, as intended, similar word arousal ratings were obtained for the two message conditions.

Filler words. The filler words that best matched the message words on individual mean arousal and mean valence ratings were included in analyses to test their suitability for the LDT in Study 2. Paired *t*-tests were then used to examine differences in arousal ratings between the physical message and corresponding filler words and between the social message words and corresponding filler words. There were no significant arousal differences between the physical message words (*M* = 3.06, *SD* = 1.11) and physical filler words (*M* = 2.56, *SD* = 0.49), *t*(12) = 1.93, *p* = .078, 95% CI [-0.07, 1.07], η^2 = .23, nor between the social message words (*M* = 3.78, *SD* = 0.92) and social filler words (*M* = 3.52, *SD* = 0.97), *t*(12) = 1.61, *p* =

.268, 95% CI [-0.23, 0.74], η^2 = .18. Thus, the physical and social message word lists and their corresponding filler word lists were matched on mean arousal, as required.

6.6.4 Word valence ratings

Message words. An independent groups *t*-test was used to assess if the words in the physical messages differed from the words in the social messages in valence (i.e., negative vs. positive) ratings. A significant difference was found between the physical (*M* = 3.97, *SD* = 1.23) and the social message word valence ratings (*M* = 5.01, *SD* = 0.90), *t*(24) = -2.45, *p* = .022, 95% CI [-1.90, -0.16], η^2 = .11. These findings suggest that participants rated the words in the physical messages as more negative than the words in the social messages (which were rated, on average, as more positive). As such, messages were revised accordingly (refer to the discussion, section 6.7 for details).

Filler words. Paired *t*-tests were used to examine the difference in valence ratings between the physical message and corresponding filler words and between the social message words and corresponding filler words. There were no significant valence differences between the physical message words (*M* = 3.97, *SD* = 1.23) and physical filler words (*M* = 4.19, *SD* = 0.85), *t*(12) = -0.83, *p* = .421, 95% CI [-0.76, 0.34], η^2 = .16, nor between the social message words (*M* = 5.01, *SD* = 0.90) and social filler words (*M* = 4.76, *SD* = 0.94), *t*(12) = 1.17, *p* = .265, 95% CI [-0.23, 0.73], η^2 = .16. Thus, the physical and social message words and their corresponding filler words were matched on valence, as intended. Tables 6.2 and 6.3 present the word ratings and other characteristics for the physical and social message words and corresponding filler words, respectively.

Table 6.2

Structural Characteristics and Participant Perceptions of the Physical Words and Corresponding Filler Words (N = 24)

Physical message words					Corresponding filler words				
Word	Length	Frequency	Arousal	Valence	Word	Length	Frequency	Arousal	Valence
each	4	253.25	1.67	4.08	easy	4	267.71	2.46	5.13
year	4	277.92	1.63	3.83	hand	4	279.65	2.08	4.17
australia	9	2.63	3.13	5.08	singapore	9	2.24	2.21	4.33
people	6	1102.98	3.13	4.42	father	6	554.49	3.46	4.63
obey	4	8.94	2.71	3.58	rank	4	8.49	2.25	3.75
one	3	3072.24	2.21	4.17	any	3	1099.37	1.75	4.13
posted	6	7.20	1.63	4.08	lounge	6	7.86	2.42	4.79
physical	8	27.18	3.63	4.13	confused	8	32.41	2.88	2.63
sustain	7	2.67	3.04	4.04	inspect	7	2.55	2.67	4.09
loved*	5	110.33	4.75	6.38	smart*	5	96.25	3.38	5.88
crash*	5	28.65	4.79	1.42	alert*	5	20.61	4.00	3.79
protect	7	70.25	-	-	forgive	7	70.25	-	-
event*	5	26.37	3.04	4.46	actor*	5	26.33	2.67	4.13
chance	6	241.24	-	-	change	6	240.34	-	-
severity*	8	0.59	4.33	2.00	swapping*	8	0.76	2.22	3.83
number	6	240.94	-	-	dinner	6	202.67	-	-
Total Means	5.81	342.09	3.05	3.97	Total Means	5.81	182.00	2.65	4.25

Note. Arousal scale (1 = *low arousal*, 7 = *high arousal*); Valence scale (1 = *negative*, 7 = *positive).* The words, ‘protect’, ‘chance’, and ‘number’ in the message word list and the words, ‘forgive’, ‘change’, and ‘dinner’ in the filler word list were not evaluated in terms of word valence and word arousal in Study 1a. ‘*’ not included in the final word list. Section 6.7 discusses this word list in further detail.

Table 6.3

Structural Characteristics and Participant Perceptions of the Social Words and Corresponding Filler Words (N = 27)

Social message words					Corresponding filler words				
Word	Length	Frequency	Arousal	Valence	Word	Length	Frequency	Arousal	Valence
choose	6	48.06	2.59	3.96	decide	6	50.14	2.85	4.03
friend	6	419.29	5.11	6.56	family	6	354.25	5.27	6.44
car	3	483.06	3.85	4.74	dad	3	507.25	4.59	5.78
showing	7	31.12	2.96	4.11	weather	7	34.24	2.96	4.11
really	6	1500.16	2.74	4.30	little	6	1446.39	2.00	3.37
care	4	485.25	4.56	5.70	hope	4	320.63	4.37	5.81
safety	6	32.33	4.44	5.78	spring	6	31.31	3.44	5.00
feel	4	627.24	4.70	4.85	must	4	699.24	2.82	3.74
comfortable	11	47.22	4.22	5.66	responsible	11	45.06	4.81	5.55
confident*	9	10.62	4.44	5.96	automatic*	9	6.98	3.22	4.52
put	3	828.45	2.19	3.63	ask	3	483.14	2.63	3.96
being	5	485.90	3.41	4.48	woman	5	434.63	3.70	5.29
best	4	404.37	3.93	5.37	real	4	442.80	3.14	4.33
Total Means	5.69	415.62	3.78	5.01	Total Means	5.69	373.54	3.52	4.76

Note. Arousal scale (1 = *low arousal*, 7 = *high arousal*); Valence scale (1 = *negative*, 7 = *positive*). '*' not included in the final word list.

6.7 Discussion

The first aim of Study 1a was to assess the validity of the manipulation of message frame. The results indicated that participants perceived the gain-framed messages to be more positive and the physical loss-framed messages to be more negative. As such, these messages were perceived by the participants as intended. However, the social loss-framed message was rated to be neutral by the participants. Further, Study 1a aimed to assess the arousal and valence ratings of the individual message and filler words. While words in the physical and social messages were matched on arousal, the findings also indicated that the physical words were perceived to be slightly more negative compared to the social words (by 1 point on a 7-point scale).

To control for this difference in perceived valence between the physical and social messages word lists in the subsequent two studies, changes were made to the physical message and word stimuli. Specifically, two words were changed in the physical messages ("risk" changed to "chance" and "severity" changed to "number") and an additional two words were changed in the physical message word stimuli list ("event" was replaced with "chance" and "crash was replaced with "protect").[22] As a result of these word changes in the physical messages, the mean word valence for these message word lists should be higher (i.e., more positive) and therefore, be more likely to match the average word valence rating of the social messages. To validate these word changes made to the physical messages and to the physical word stimuli list, an additional word valence manipulation check was included in Study 2 (the results from Study 2 indicated that the words included in the social and physical messages were matched on valence. See chapter 7, section 7.5.4). Finally, the filler words

[22] Despite the word changes in the physical messages and word list, similar word frequencies were still obtained for the physical and social message conditions.

that best matched the message words in terms of perceived arousal and valence ratings were retained for inclusion in the LDT in Study 2.

Study 1b: Piloting of the motor vehicle message

6.8 Method

6.8.1 Participants

A total of 21 participants were recruited via email and online advertisements. Of those participants, 18 were undergraduate students and three were recruited from the local community. Selection criteria included being between 17 and 25 years of age and holding a current provisional or open Australian driver's licence (8 held an open licence, 13 provisional restricted licence). The participants (17 female) had a mean age of 20.06 years (*SD* = 2.40). Seventeen participants listed English as their first language. Of the 21 participants, 14 (66.7%) reported regularly driving over the posted speed limit. The undergraduate participants were offered partial course credit of 0.5% for their time. All other participants were offered a chance to receive one AUD$50 shopping gift card.

6.8.2 Design

Paired *t*-tests assessed participants' valence and arousal ratings of the words included in the motor vehicle message. Independent groups *t*-tests were used to compare the word arousal and valence ratings between the motor vehicle message and the social messages (from Study 1a), which were used in Study 2 to activate the BIS.

6.8.3 Materials and Procedure

The participants completed an online self-report questionnaire, which took approximately 10 minutes to complete. As per Study 1a, participants were required to answer questions that related to their demographic information (e.g., age and gender) and driving history (e.g., type of drivers licence), and current on-road speeding behaviour. Participants were then asked to read the motor vehicle message and rate the credibility of the vehicle message on a 7-point semantic differential scale (1 = *unbelievabl*e, 7 = *believable*; MacKenzie & Lutz, 1989). Cronbach's alpha for the credibility scale was found to be acceptable (α = .90; i.e., α ≥ .70, Cronbach, 1951). Next, using a 7-point semantic differential scale, participants were asked to rate the arousal (1 = *low arousal*, 7 = *high arousal*; Aquino & Arnell, 2007) and valence (1 = *negative*, 7 = *positive*) of the words included in the message and the corresponding filler words.

6.9 Results

6.9.1 Preliminary checks

Missing data and assumption checks. There were no missing data. All relevant assumptions were met, unless otherwise stated in the results.

Baseline group checks. To assess if any pre-existing group differences existed between the participants who viewed the motor vehicle message and the participants who viewed the social messages, a series of chi-square frequency tests and an independent groups *t*-test were conducted. The results showed that there were no significant differences between those participants that viewed the motor vehicle message compared to those that viewed the social messages on gender $\chi^2(1) = 0.96$, $p = 1.00$, type of driver's licence $\chi^2(1) = 0.30$, $p = .371$, and speeding behaviour $\chi^2(1) = 0.48$, $p = .541$. Further, an independent groups *t*-test indicated that there were no significant age differences between those individuals who viewed the motor vehicle message ($M = 20.06$, $SD = 2.40$) and those individuals who viewed the social messages ($M = 19.25$, $SD = 2.30$), $t(46) = 1.19$, $p = .241$, 95% CI [-0.56, 2.18].

6.9.2 Motor vehicle manipulation checks

The mean score on the 7-point credibility scale (1 = *unbelievable*, 7 = *believable*) indicated that, on average, participants perceived the motor vehicle message to be "neither unbelievable nor believable" ($M = 4.29$, $SD = 1.10$).

6.9.3 Word arousal ratings

Motor vehicle message and filler word ratings. A paired *t*-test showed that there were no significant difference between message words ($M = 3.30$, $SD = 0.79$) and filler words

(*M* = 3.25, *SD* = 0.90) on word arousal ratings, $t(12) = 0.14$, $p = .891$, 95% CI [-0.68, 0.77], $\eta^2 = .00$. Thus, consistent with expectations, similar word arousal ratings were obtained for the message words and matched filler words.

Motor vehicle message and social message word ratings. An independent groups *t*-test was used to examine the word arousal differences between the motor vehicle message and social loss-framed message.[23] The results showed that there was no significant difference between the social message words (*M* = 3.78, *SD* = 0.91) and motor vehicle message words (*M* = 3.29, *SD* = 0.79) on arousal ratings, $t(24) = -1.43$, $p = .165$, 95% CI [-0.21, 1.18], $\eta^2 = .07$. Thus, as anticipated, similar word arousal ratings were obtained for the words used in the motor vehicle message and the social loss-framed message.[24]

6.9.4 Word valence ratings

Motor vehicle message and filler word ratings. A paired *t*-test revealed that there were no significant difference between message words (*M* = 4.80, *SD* = 0.74) and filler words (*M* = 4.54, *SD* = 0.51) on word valence ratings, $t(12) = 1.15$, $p = .274$, 95% CI [-0.23, 0.73], $\eta^2 = .10$. Thus, as intended, similar word valence ratings were obtained for the message words and matched filler words.

Motor vehicle message and social message word ratings. An independent groups *t*-test revealed that there were no significant difference between the social message words (*M* = 5.01, *SD* = 0.90) and motor vehicle message words (*M* = 4.80, *SD* = 0.74) on valence ratings, $t(24) = 0.66$, $p = .518$, 95% CI [-0.45, 0.88], $\eta^2 = .01$. Thus, as expected, similar valence

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[23] The motor vehicle message and the social loss-frame message were used in Study 2 to activate the BIS (i.e., the vehicle message was developed to activate the BAS and the social loss-frame message was developed to activate the FFFS).

[24] While it is acknowledged that Study 1a combined both the social loss-framed and gain-framed messages, the words included in these messages were exactly the same (with the exception of seven words that were used to change message frame and were not included in the LDT word list; refer to Table 6.1). As such, there should be no difference between word arousal and word valence ratings between these two message conditions.

ratings were obtained for the words in the motor vehicle message and the words used in the social loss-framed message. Table 6.4 presents the motor vehicle message words and corresponding filler words.

6.10 Discussion

The first aim of Study 1b was to assess the credibility of the motor vehicle message. The findings showed that, on average, participants perceived this message to be neither unbelievable nor believable. As such, the credibility of the motor vehicle message was examined in Study 1c to further explore participants' reactions towards this vehicle message and to assess if this message was suitable to activate the BAS in Study 2.

To reduce any potential word confounds in subsequent studies, the second aim of Study 1b was to compare the arousal and valence ratings of the word stimuli included in the motor vehicle message with the social loss-framed messages and to match filler words to those words included in the vehicle message. The findings indicated that words in the vehicle and social messages were matched on arousal and valence ratings. Consequently, it was concluded that there were no significant word confounds that should significantly influence the findings in Study 2. Further, the filler words that best matched the vehicle message words in terms of perceived arousal and valence ratings were retained for inclusion in the LDT in Study 2.

On completion of Studies 1a and 1b, additional participants were recruited for a series of small focus group discussions to further explore young drivers' thoughts and feelings towards the refined road safety and motor vehicle messages and to follow-up on the self-reported responses reported in these two studies. Specifically, the discussions were designed to probe message frame (i.e., gain and loss-framed), message type (i.e., physical and social), and the credibility of the vehicle message (i.e., believable or unbelievable) and, in turn, provide a stronger rationale for selecting this stimuli to assess the revised RST in Study 2.

Table 6.4

Structural Characteristics and Participant Perceptions of the Motor Vehicle Words and Corresponding Filler Words (N = 21)

Motor vehicle message words					Corresponding filler words				
Word	Length	Frequency	Arousal	Valence	Word	Length	Frequency	Arousal	Valence
achieve	7	7.33	4.43	6.10	applied	7	6.16	2.48	4.57
exceeds	7	0.73	4.86	5.57	compile	7	0.53	2.29	4.05
vehicle	7	22.61	3.05	4.15	journey	7	19.94	4.40	5.19
powered	7	1.37	3.55	5.29	immense	7	1.61	4.62	5.00
engine	6	31.88	3.38	4.35	market	6	36.24	3.38	4.29
reaches	7	5.24	3.14	5.05	reflect	7	4.18	2.71	4.29
top	3	133.43	3.67	5.35	hot	3	189.84	4.62	4.62
fastest*	7	5.84	4.62	5.70	quicker*	7	7.18	3.95	5.24
street	6	148.18	2.24	3.85	answer	6	176.20	3.05	4.38
permitted	9	4.35	2.43	4.38	entertain	9	6.14	3.81	5.24
test	4	84.08	2.52	4.57	list	4	80.59	2.38	3.75
today	5	433.80	3.19	4.29	house	5	514.00	3.05	4.40
all	3	5161.86	2.52	4.57	get	3	4583.76	2.00	3.95
Total Means	6	464.67	3.35	4.86	Total Means	6	432.80	3.29	4.54

Note. Arousal scale (1 = *low arousal*, 7 = *high arousal*); Valence scale (1 = *negative*, 7 = *positive*). '*' not included in the final word list.

Study 1c: Qualitative analysis of the road safety and motor vehicle messages[25]

Study 1c aimed to further explore young drivers' thoughts and feelings towards the road safety messages and motor vehicle message via qualitative methods. Specifically, Study 1c explored if participants could identify that the road safety messages differed in frame (i.e., gain and loss) and type (i.e., physical and social). Considering the self-report data in Study 1b showed that participants perceived the motor vehicle message to be neither believable nor unbelievable, this study was also designed to further assess the credibility of this message and to test if it would be an appropriate stimulus to activate the BAS in Study 2.

6.11 Method

6.11.1 Participants

A total of 17 young licensed drivers (11 males), were recruited from an undergraduate student cohort via email and course websites to take part in interviews or small group discussions of up to three individuals. Three interviews and six group discussions were undertaken over the course of the data collection. Conducting group discussions and interviews simultaneously (Lambert & Loiselle, 2008) enabled triangulation of method and specifically enabled the researchers to achieve a greater understanding of young drivers' perceptions towards road safety messages and a motor vehicle message and reach data saturation. Out of respect for an individual's time and interest in the study, an interview was conducted if one participant signed up or attended the session.[26] Participants were recruited until data saturation had occurred; until it was considered that no new information was being provided by the participants (Morgan, 1998). Selection criteria required participants to be between 17 and 25 years of age (M = 19.65, SD = 1.37) and to hold a current Australian Open

[25] Parts of Study 1c have been taken from a paper that is currently under review: Kaye, S., White, M., & Lewis, I. (under review). Young drivers' perceptions of road safety messages and a high performance vehicle advertisement: A qualitative exploration.

[26] From this point forward, the term 'discussions' will be used when referring to interviews and group discussions.

or Provisional driver's licence (*n* = 3 Open licence, *n* = 14 Provisional/ restricted licence). All participants reported that they regularly drove over the recommended speed limit. Thus, speeding was prevalent among this group of young drivers, suggesting potentially high levels of behavioural involvement in terms of current engagement in speeding behaviour. Participants were provided with light refreshments and received partial course credit (i.e., 2.5%) for their time.

6.11.2 Materials

A semi-structured interview schedule was used to guide discussions (see Appendix A). Participants were informed that message persuasiveness referred to the extent to which they perceived the message(s) to be successful at convincing both themself and other road users to reduce their speeding behaviour. Further, all messages were presented to participants as written concept outlines and each typed in 16-point Times New Roman font on a separate A4 sheet of paper.

6.11.3 Procedure

Discussions were undertaken in a small quiet room located on a university campus, with most participant discussions ranging from 35 minutes to 1 hour. All sessions were audio recorded and the moderator took notes during the sessions to record any key comments and non-verbal cues. To increase the likelihood that the participants would feel comfortable to share their thoughts and feelings and to provide honest information, the moderator and participant(s) were the only persons present during the discussions.

Prior to the discussions, participants were asked to sign a consent form and to complete a short self-report questionnaire that consisted of demographic items (e.g., age and gender). At the start of each session, the participants were informed that the purpose of the research was to gain a greater understanding of young drivers' perceptions of road safety campaigns. The moderator commenced the discussions by asking general questions on current road safety campaigns to engage participants in the topic of interest. Once the moderator perceived that all participants appeared comfortable sharing their thoughts and feelings towards current road safety campaigns, participants were presented with the anti-speeding messages. To enable the moderator to explore participants' thoughts and feelings to each individual message, all messages were presented to each participant, however each was presented one at a time and they were counterbalanced throughout the sessions to reduce any potential order and/ or fatigue effects. Further, to avoid influencing participants' responses towards the messages, participants were not informed that the anti-speeding messages differed in message frame or type.

On completion of discussing the anti-speeding messages, participants were provided with and read the motor vehicle message. The motor vehicle message was presented last in each session as the first key objective was to assess participants' responses to the road safety messages, prior to assessing their responses to the motor vehicle message and the potential persuasive (or dissuasive) effects associated with conflicting information cues. All discussions concluded with the moderator providing a summary of key points to the participants to check for understanding and to clarify any discrepancies. No discrepancies were stated by the participants.

6.11.4 Data Analysis

Discussion recordings were transcribed verbatim. By moderating the discussions and transcribing the data, the author was able to become familiar with the data, enhancing the reliability and trustworthiness of the analysis. Thematic analysis was conducted to provide a systematic analysis of the data and concept-driven coding was used to generate initial codes (Braun & Clarke, 2006). The codes were initially derived separately for each road safety message and the motor vehicle message. However, to ensure that any unexpected findings were not overlooked, additional codes were created for responses that were outside of the key areas of interest. Themes were then identified by reviewing the frequency and extensiveness of the coded data across all transcripts. The process of creating and reviewing themes from the coded data continued until no new themes were identified. To enhance both the reliability and the validity of the data, the author's supervisors (who were also involved in the study's design and are experienced researchers in road safety and young drivers) worked together with the author to refine the themes. As such, the findings presented in this study are believed to provide a comprehensive and reliable interpretation of the data. Themes are highlighted in the following section by the provision of participant quotes. To ensure participants' anonymity, all quotes provided are cited only in terms of age and gender of the participant (e.g., 17M is a 17 year old male).

6.12 Results and Discussion

6.12.1 Message manipulation checks

Message frame. As predicted, participants perceived the gain-framed and loss-framed messages to contain positive and negative cues, respectively. For the loss-framed messages, participants used the words 'scare tactics', 'blaming drivers', 'uses guilt as a deterrent', 'negative message' and 'punished for negative behaviour' to describe the physical and social loss-framed messages. As discussed in chapter 2, the FFFS is activated on presentation of threat-based/ aversive stimuli (Corr, 2008). As these findings highlight, the loss-framed messages contained aversive cues and were therefore considered suitable stimuli to activate the FFFS in Study 2.

For the gain-framed messages, participants used the following words to describe these messages, 'rewarded for good behaviour', 'positive spin', 'positive message' and 'praising drivers'. The BAS is activated on the presentation of reward stimuli (Corr, 2008) and as these responses highlight, participants perceived the gain-framed messages to include reward cues.

As such, the physical and social gain-framed messages were considered to be suitable stimuli to activate the BAS in the subsequent study.

Message types. While all participants stated that the social messages included social cues (e.g., social approval [gain-framed] and social disapproval [loss-framed]) and the physical message included physical cues (e.g., increasing and preventing physical injury in the loss and gain-framed messages, respectively), some participants stated that the physical messages also contained social cues.

> "The fact that it [physical loss-framed message] is referencing people that I care about, that reminds you of... if I'm driving with my parents and partner in the car, if I crash I'm not just causing potential injury or death to myself but, to someone that I love" (20M)
>
> "I can see how "not protecting yourself and your loved ones" is trying to make it more personal for people... again mentioning your passengers as well, so you're thinking about the effect that speeding would have on other people in your car" (21F)
>
> "I guess what popped up was protecting yourself and your loved ones..." (19M)

These comments highlight that participants perceived the words that related to their loved ones and passengers to be of a social nature. Thus, to ensure that the physical messages only contained physical cues, the following words,"... and your loved ones" and "... you and your passengers", were excluded from the physical message stimuli in Study 2. Further, as the word, 'loved', was included in the physical word stimuli list, the physical word list was reduced from 13 to 12 words in Study 2. To ensure consistency between the road safety message and vehicle message conditions, the words 'confident' and 'fastest' were excluded from the social messages and vehicle message word lists, respectively, for Study 2.[27]

[27] The words, 'confident' and 'fastest' were removed from the list as participant's in Study 1a rated these two words to be similar in both valence and arousal as the word 'loved'.

6.12.2 Message persuasiveness

Loss-framed anti-speeding messages. For the loss-framed messages, two main themes were identified. The first theme, sense of responsibility towards passengers was identified to influence the persuasiveness of the social loss-framed message. While message repetition effects, in terms of the potential desensitisation to the physical loss-framed message as a result of previous exposure to similar types of physical consequences, was identified as influencing the persuasiveness of the physical message among this sample of young drivers.

Sense of responsibility towards passengers. Only male participants (all except one male) perceived the social loss-framed message to be persuasive, stating that they felt a stronger sense of responsibility towards their passengers after viewing the social loss-framed message. After reading the social loss-framed message, the majority of male participants acknowledged the impact that their own speeding behaviour would have on their passengers and/ or their friends.

> "The idea of making someone feel uncomfortable, especially someone that you care about, that might be a bit more of a reason to slow down as opposed to making friends feel comfortable" (20M)
>
> "I can almost picture it, you're speeding with your friends in the car and for me I can just see myself doing that and now I'm thinking well I am endangering my friends' lives" (19M)
>
> "After reading the first sentence it made me think from the perspective of a passenger. It just instantly made me realise that this is true, this is probably how people think in the car with you and even just from the first word, I'm paying attention, I'm absorbing it" (19M)

Research has reported that young male drivers are more likely to participate in risky driving behaviours, such as speeding, compared to their female counterparts (Harré et al., 1996). Thus, it has been well acknowledged that road safety messages need to be specifically designed to target this high risk group. As shown in Study 1c and supported by previous research, social messages may be an alternative option, compared to the more predominant physical threat messages to persuade young male drivers to adopt safer driving behaviours (Lewis et al., 2008a).

In contrast, and reflecting a point of departure between males and females, female participants (with one exception) expressed negative reactions towards the social loss-framed message.

> "I kind of get annoyed by that message, purely because I think that it's a bit of a generalisation that friends would think that you're not caring about them" (19F)
>
> "It does annoy me because it's telling me this assumption that you don't care about your friends" (17F)
>
> "It makes you a bit annoyed actually... you're assuming that I speed with my friends, well I don't" (21F)

These responses suggest that most female participants in Study 1c were unlikely to be persuaded by the social loss-framed message. In particular, the majority of female participants perceived that this message was suggesting that they do not care for the safety of their friends and found this inference somewhat offensive. Findings revealed, however, that female participants showed more favourable responses towards the social gain-framed message, even though the content in the social loss-framed message was exactly the same as the content in the social gain-framed message except for message frame. Thus, this finding suggests that message frame may be an important influence upon the persuasiveness of road safety messages for young drivers and, that such subtleties need to be considered carefully in advertisement design.

While young female drivers have a lower crash risk compared to their male counterparts (Monárrez-Espino et al., 2006), recent research has reported that young female drivers are becoming more susceptible to road crashes due to an increase in their own risk taking behaviours (Romano et al., 2008). In this study, both male and female participants reported that they regularly drove over the posted speed limit. Thus, it appeared that gender differences towards the perceived persuasiveness of the social loss-framed messages was not due to differences in the extent to which males and females (self) reported engagement in speeding behaviour. As previously mentioned, female drivers have been reported as being more persuaded by physical threats than male drivers (Goldenbeld et al., 2008; Lewis et al., 2007). Thus, instead of challenging the belief that one does not care about their friends, road safety messages designed to target young female drivers could instead focus upon the physical implications of road crashes (Goldenbeld et al., 2008).

Message repetition effects. The second main theme that was identified for the loss-framed messages was that some participants reported that previous exposure and repetition of physical threats in the media for road safety campaigns (e.g., death and injury) reduced the persuasiveness of the physical loss-framed message.

> "They're all the same, you've seen one of them, you've seen them all" (19M)
>
> "It gives you a statistic and tells you that if you speed you might injure or kill yourself which is something that you've already been told like a thousand times over" (21M)
>
> "I assume that these campaigns [threat-based messages] have been around 20-30 years, so I guess our generation is..." (23M), "Bored with them" (19F), "Maybe desensitised to them, cause they've just been around forever, our whole life spans" (23M)

While previous research has reported that fear has the greatest effect immediately following message exposure (Evans, Rozelle, Lasater, Dembroski, & Allen, 1970; Lewis et al., 2008a), message wear out effects mean that message persuasiveness decreases over time and exposure (Fry, 1996; Schoenbachler & Whittle, 1996). Road safety campaigns in Australia typically use physical threat-based appeals to emphasise the negative consequences of speeding behaviour (Lewis et al., 2010; Tay & Watson, 2002). However, as these findings highlight, some young drivers felt desensitised to these physical consequences due to previous media exposure. In particular, male participants were more likely to report message repetition effects than female participants. Thus, consistent with previous research (Goldenbeld et al., 2008; Lewis et al., 2007), this finding further supports the suggestion that male drivers may find road safety incorporating social consequences to be more persuasive whereas female drivers may be more persuaded by road safety messages that focus on the physical consequences. Based on these group differences towards the road safety messages, potential gender differences in message acceptance ratings (as measured by message effectiveness, behavioural intentions, attitudes, and self-report actual behaviour) were first evaluated in Study 2 to ensure that gender would not confound the main findings.

Gain-framed anti-speeding messages. Personal relevance and social esteem were identified as the two main themes in terms of factors influencing the persuasiveness of the social and physical gain-framed messages, respectively.

Personal relevance. Gain-framed messages that focused on friends and family were perceived by the majority of participants to be more relevant and, in turn, more persuasive, than those messages that focused on other road users.

> "You'd be more conscious of what you're doing [with friends in the car]" (19M)
>
> "I think that if they could target responsibility, they would get a lot further. That [social gain-framed message] is a good way of doing it" (19F)

"I think the idea of being a good friend and having the responsibility for other people, it's just more immediate than a random figure of the people who will die or have injuries" (21F)

"If it's just 400 random people, I know that that's still much larger but, if its people close to you, I reckon that will help stop, prevent or deter people" (18F)

"This is probably going to sound horrible but, 400 people out of that many [the number of people who drive] doesn't seem like a lot. It would probably be different it was someone that you cared about or who was close to you" (19F)

As these comments highlight, participants expressed greater concern for protecting their friends and family than for other road users. Past theoretical (e.g., Elaboration Likelihood Model; Petty & Cacioppo, 1986) and empirical evidence (LaTour & Rotfeld, 1997; Lewis et al., 2007; Millar & Millar, 2000) has reported that individuals who perceive health messages as being personally relevant are more likely to be persuaded by a message (see chapter 3, section 3.4.2). One way to enhance personal relevance is to tailor the message to the target audience (Kreuter & Wray, 2003). Thus, road safety messages that emphasise the positive consequences that obeying the speed limit would have on one's friends and/ or family (e.g., protecting the lives of their loved ones), may be more relevant to young road users. Further, these messages may be more persuasive for this age group than messages reflecting consequences for the broader community.

Social esteem. In terms of the physical gain-framed message, promoting a sense of social esteem was reported by some participants to increase the persuasiveness of the message. In this context, the researchers defined social esteem as feeling good about one's self by obeying the road rules and protecting the safety of other drivers.

"I think that everyone likes to be a little heroic" (21F)

"Cause of the positive spin, it's nice. It's like you have the opportunity to save lives as opposed to, you have the possibility not to die, like, everyone wants to feel like a hero" (19M)

"It's more reaffirming [than the loss-framed messages], almost praising them for safe driving and it gives people the idea that when you're safe you're achieving something" (19M)

Overall message persuasiveness. After participants were exposed to the four anti-speeding messages they were asked, "Of the four road safety messages, which message(s) would you find most effective?" Responses to this question varied among participants. While some participants reported the loss-framed messages, others reported the gain-framed messages, to be more persuasive. Further, some participants overlooked message frame and instead based their decision on the type of message (i.e., physical or social messages). This finding supports the notion that 'one size does not fit all' and further emphasises the need to implement a range of both loss-framed and gain-framed road safety messages to adequately capture the attention of and ultimately persuade all young drivers.

All but one participant indicated that they would find at least one of the anti-speeding messages to be persuasive. However, some participants, particularly the males, stated that other groups of road users (i.e., learner and middle aged drivers) would be more persuaded by the four road safety messages than young drivers. Consistent with previous road safety research that has explored the construct of the Third-person Effect (TPE; Lewis et al., 1997), this finding suggests that young male drivers may perceive that other drivers are more persuaded by road safety messages than themselves. Further, as one participant noted, young drivers may be less inclined to abide by road safety messages as they may perceive other road users as having a greater crash risk compared to themselves (i.e., existence of optimism bias in the road safety context; White et al., 2011).

"I think [the physical messages would be more effective for] maybe older people more than younger people, just knowing my friends, I think they'd be like, yeah whatever, this message doesn't really appeal to me, it doesn't really matter... because I'm not going to kill them" (19F)

6.12.3 Pilot testing of the motor vehicle message

Credibility of the motor vehicle message. All participants stated that the motor vehicle message was believable. As the following comment from one of the participants suggests, which reflected the sentiment of most others, making changes to the message may decrease message persuasiveness.

"As a younger driver, if you did change it [the motor vehicle message] I'd probably lose interest" (20M)

While all participants perceived the motor vehicle message to be believable, suggestions on how to enhance the persuasiveness of this message differed according to gender. Specifically, female participants provided suggestions on how to make the motor vehicle message safer, while some of the male drivers stated that an increase in engine size and power of the vehicle would increase the persuasiveness of the message.

"Like V10, V12, the higher you go the more impressive it becomes" (20M)

"... if it [the motor vehicle message] said twin turbo V4, I'd probably be more interested" (20M)

In Australia, smaller powered engines are more common than higher power engines, such as V10, V12, or twin turbo V4 engines (Australian Government, 2011). In an attempt to make the vehicle message more relevant to the majority of young drivers, it was decided that no changes would be made to increase the vehicle's engine size in this message. Further, as the vehicle stimulus was included in Study 2 to activate the BIS (i.e., examine participant reactions to competing reward and punishment goals between the motor vehicle message

(BAS) and social loss-framed message (FFFS)), no changes were made to improve the safety of the vehicle presented in the vehicle message.

Motor vehicle message and gender differences. As found in relation to the road safety messages, participants' reactions towards the motor vehicle message appeared to differ according to gender. Specifically, while male participants found the motor vehicle message to be persuasive, female participants were not persuaded and instead perceived the vehicle message to be irresponsible. For instance, male participants responded favourably towards the motor vehicle message and all but one male stated that they wanted to test drive the vehicle presented in this message.

"It's awesome, I want this car" (19M)

"Driving cars like that is fun..." (21M)

"It's not really about the 'envy of all your mates', screw my mates, I just want to drive that car" (19M)

"If I had the opportunity I would test drive it [the car]. I would be like, yes please" (20M)

"I would test drive it [the car]... it would be pretty fun I think" (21M)

Such comments suggest that the male participants liked and were potentially persuaded by this vehicle message. In contrast to the male participants, female participants appeared not to be persuaded by the motor vehicle message and instead identified that it promoted dangerous behaviour.

"That's a dangerous car. I guess that guys would like it. It doesn't really appeal to me cause I don't want a dangerous car" (18F)

"It doesn't say that speeding is good but, it kind of says like, look, this is what you can do" (19F) "Totally irresponsible" (21F) "Like come buy our car and jump on the highway and go insane" (19F) "It's like challenging people almost. See how fast you can go without getting caught" (21F) "That's exactly what it's like" (19F)

"It just doesn't appeal to me because just driving at 110 is a bit scary for me" (17F)

Such findings suggest that the promotion of high performance vehicles in advertisements may not appeal to young female drivers. Unlike male participants, female participants perceived the vehicle in the message to be dangerous and unsafe. As discussed in chapter 4, one explanation for this finding may be that male drivers consider risky driving behaviours to be more acceptable compared to female drivers (Redshaw, 2006). Further, previous research has reported that male drivers invest more of their identity into the performance of a motor vehicle than female drivers (Steg, 2005). Thus, since male drivers may place stronger importance on the performance of their vehicles, exposure to high performance advertisements may be more appealing to this cohort of drivers compared to female drivers. However, it should also be noted and acknowledged that viewing the road safety messages first may have primed female participants to have heightened negative reactions towards the vehicle message.

Motor vehicle message and the BAS. For the motor vehicle message, only the male participants perceived this message to include reward cues.

"With younger people they can't drive it but, it sounds like a fantasy... it's something to look forward to" (19M)

"I'm going to see how fast she can go, you know, like you just get excited... it's very exciting" (19M)

"To experience 0-100 in 6 seconds, that sort of acceleration would be exciting" (20M)

These responses highlight that the description of the vehicle presented in the message elicited positive emotions for the majority of male participants. As discussed in chapter 2, section 2.2.3 the BAS is activated on the anticipation of receiving a reward, not actually obtaining the reward per se (Smillie et al., 2011). While the majority of male participants acknowledged that they are unable to drive this high performance vehicle due to licence restrictions,[28] their comments indicated that the thought of driving this vehicle would be exciting and in the words of one participant '...something to look forward to". Thus, the motor vehicle message was considered an appropriate stimulus to activate the BAS and, as such, no changes were made to this message for Study 2.

6.13 Overall Summary of Study 1

The overall purpose of Study 1 was to pilot and refine the road safety messages and the motor vehicle message to be used in Study 2 (see Table 6.5 for the final, revised road safety messages; no changes were made to the motor vehicle message that was previously presented on page 84). A range of pre-checks were conducted to test the validity of these message stimuli. Study 1a aimed to assess the validity of manipulation of message frame, while Study 1b aimed to assess the credibility of the motor vehicle message. Further, both Studies 1a and 1b aimed to assess the arousal and valence ratings of the words included in the road safety and motor vehicle messages, respectively. Finally, Study 1c aimed to further explore young drivers' thoughts and feeling towards the road safety messages and motor vehicle message using in-depth qualitative methods. Study 1c also explored if the motor vehicle message would be a suitable stimulus to activate the BAS in Study 2.

[28] Young drivers' who hold a P1 or P2 restricted drivers' licence are only permitted to drive vehicles that contain up to six cylinders (Department of Transport and Main Roads, 2012).

Table 6.5

Final Road Safety Message Stimuli

Physical loss-framed message

Each year in Australia, approximately 400 people will ***die*** if drivers ***do not*** obey the speed limits

By ***not*** obeying the speed limits, you are ***increasing*** your chance of crashing and ***not*** protecting yourself

Driving ***over*** the posted speed limit ***increases*** the number of physical injuries one may sustain in the event of a crash

Slow down, monitor your speed

Physical gain-framed message

Each year in Australia, approximately 400 people will be ***saved*** if drivers ***were to*** obey the speed limits

By obeying the speed limits, you are ***decreasing*** your chance of crashing and protecting yourself

Driving ***under*** the posted speed limit ***decreases*** the number of physical injuries one may sustain in the event of a crash

Slow down, monitor your speed

Social loss-framed message

When you choose to speed with your friends in the car, you're showing them that you really ***don't*** care about their safety

Although they probably won't say it, your friends will feel ***less*** comfortable and ***less*** confident with you as a driver when you ***do*** speed

By speeding, you're ***not*** putting your friends' safety first and ***not*** being the best friends you can be

Slow down, monitor your speed

Social gain-framed message

When you choose ***not*** to speed with your friends in the car, you're showing them that you really ***do*** care about their safety

Although they probably won't say it, your friends will feel ***more*** comfortable and ***more*** confident with you as a driver when you ***don't*** speed

By ***not*** speeding, you're putting your friends' safety first and being the best friend you can be

Slow down, monitor your speed

Note. Differences between the gain-framed and loss-framed messages are highlighted in bold.

For the road safety messages, participants perceived the gain-framed messages to include reward/ positive cues and the loss-framed messages to include punishment/ negative cues. However, while the social messages were perceived by participants to include social cues, some participants in Study 1c perceived that the physical messages contained both physical and social cues. The physical messages were altered to ensure that these messages only consisted of physical cues (with checks again conducted in Study 2). Further, Study 1a findings suggest that words in the physical messages were rated more negatively compared to the words in the social message which were rated more positively. Thus, word changes were made to the physical message and physical word list to increase the likelihood that word valence would be similar between the two message conditions in Study 2 (see Section 6.7). Gender differences in message persuasiveness were also evident from the group discussion findings. As such, the decision was made to ensure that Study 2 included pre-data checks to examine if gender differences influenced participants' reactions towards the social and physical gain-framed messages and subsequent activation of the BAS, and towards the social and physical loss-framed messages and subsequent activation of the FFFS.

Additional findings from Study 1c indicated that optimism bias (i.e., younger drivers perceiving other drivers to have a greater crash risk) and the TPE (i.e., participants perceiving that learner and older drivers would be more persuaded by the road safety messages) may have influenced participants' overall perceived message effectiveness ratings. Optimism bias and the TPE were, subsequently, assessed in Study 2 to examine if this construct influenced message acceptance.

For the motor vehicle message, given the mid-point score on the credibility scale in Study 1b, the qualitative study (Study 1c) was designed to further explore the believability of this message. In Study 1c, all participants stated that they perceived the motor vehicle message to be believable. Based on these follow-up findings from the group discussions in Study 1c, no changes were made to increase the credibility of the vehicle message for Study 2. Further, the results showed that while male participants were persuaded by the vehicle message and perceived this message to include reward cues, female participants were not persuaded by the vehicle message and instead perceived the message to promote dangerous driving behaviour. As the vehicle message was designed to be viewed in conjunction with the social loss-framed message in Study 2, to activate the BIS, no changes were made to enhance the safety of the vehicle presented in the message. Similar to the road safety message stimuli the decision was made to ensure that Study 2 examined if any gender differences influenced participants' reactions towards the motor vehicle message and subsequent activation of the BIS. As discussed in chapter 2, the BIS is activated when conflict occurs between two competing goals (Corr, 2008). To investigate if a goal of a participant was to drive the vehicle presented in the message, a 6-item Goal Scale was developed and included in Study 2. For the social loss-framed message, a 5-item behavioural intentions scale was used to assess one's goals of adopting the recommendations of this message (see chapter 7, sections 7.4.3.5 and 7.4.3.6, for further information on these goal and behavioural intensions measures).

6.13.1 Limitations and future research

While the current study assessed the arousal ratings of the individual words included in the road safety and vehicle messages, one limitation of Studies 1a and 1b was that a measure was not included to assess the perceived arousal ratings of the messages in their entirety. To control for potential confounds associated with arousal, the decision was made to ensure inclusion of an additional self-reported arousal measure in Study 2 to examine if participants perceived the four road safety messages and motor vehicle message to differ in arousal. Further, across all phases of Study 1 (a, b, c) the sample consisted of a large proportion of university students and, overall, consisted mostly of females. Since Studies 2, 3a, and 3b would recruit similar participants, the sample in Studies 1a, 1b, and 1c were not considered a limitation in this research program. However, it should be noted that this sample may not be representative of the general population and care should be taken when comparing these findings outside the current program of research.

The gain-framed messages were designed to activate the BAS, while the loss-framed messages were designed to activate the FFFS, which prior research has supported (Kaye et al., 2013). Likewise, the current findings of Studies 1a and 1c have indicated that participants perceived the gain-framed and loss-framed messages to be functioning as intended (i.e., gain-framed messages consisted of positive/ gain cues and the loss-framed messages included negative/ loss cues). Despite these findings it is acknowledged, however, that some individuals may perceive the physical gain-framed message as focusing on physical losses. For instance, the physical gain-framed message depicts that by not speeding, drivers are decreasing their risk of injury and/or crash involvement. Typically, a gain-framed message would focus on the gains associated with increasing a safe behaviour (e.g., staying healthy by increasing exercise and/or one's intake of fruit and vegetables). The wording of these messages was restricted by the experimental approach that attempted to control for additional wording confounds by presenting identical information in the gain-framed and loss-framed messages. As such, differences in interpretation of the physical gain-framed message should be considered when interpreting Study 2 findings.

6.14 Chapter Summary

The overall findings from Study 1 were used to enhance the message stimuli for Studies 2 and 3. As highlighted by Corr (2013), validation of reward and punishment stimuli is essential to ensure that these stimuli can activate the BAS and the FFFS, respectively. In the current study, the gain-framed road safety messages and motor vehicle message were deemed appropriate stimuli to activate the BAS in young drivers, since they were perceived by participants to include positive/ reward cues, while the loss-framed road safety messages were deemed appropriate stimuli to activate the FFFS in young drivers, since they were perceived to included negative/ punishment cues.

Chapter 7. Study 2: Examining the Influence of RST on Message Processing and Subsequent Message Acceptance

7.1 Chapter Overview

This chapter presents the main study of the program of research that was designed to assess if individual differences in the Reinforcement Sensitivity Theory (RST) traits influence health message processing and subsequent message acceptance. First, a brief introduction of Study 2 is presented, prior to outlining its key aims and hypotheses, followed by the study's details (methods, results, and discussion).

7.2 Introduction

Studies 1a-c piloted the road safety and motor vehicle messages on a sample of young adults, to assess if the stimuli were suitable to activate the Behavioural Approach System (BAS), the Fight-Flight-Freeze (FFFS), and the Behavioural Inhibition System (BIS) in Study 2. Overall, Study 1 revealed that the gain-framed road safety messages and motor vehicle message were appropriate to activate the BAS, while the loss-framed road safety messages were suitable to activate the FFFS. Thus, all message stimuli were included in Study 2 (see pages 80 and 112 for the message stimuli).

Study 2 was designed to address the first overall aim of this program of research, to examine the extent to which individual differences, as conceptualised by Gray and McNaughton's (2000) revised BAS, FFFS, and BIS traits, influence young drivers' processing and subsequent acceptance of gain-framed and loss-framed anti-speeding road safety messages and mixed message cues. As previously outlined in chapter 2, Gray and McNaughton's (2000) revised RST proposes that three neural-based motivational systems underlie behaviour: the BAS, the FFFS, and the BIS. The revised BAS is activated by reward stimuli and results in approach behaviour (Gray & McNaughton, 2000). Individuals with a stronger BAS are more sensitive to cues of reward and therefore, more likely to approach incentive cues compared to those with a weaker BAS (Corr, 2008). The revised FFFS is proposed to be activated by punishment stimuli and results in avoidance behaviour (Gray & McNaughton, 2000). Accordingly, individuals with a stronger FFFS are more sensitive to cues associated with punishment. Finally, the revised BIS is activated on presentation of conflicting cues, such as simultaneous BAS-FFFS, FFFS-FFFS, or BAS-BAS cues associated with the same goal behaviour (Corr, 2008).

Previous research in the health communication field that has assessed the relative effectiveness of gain-framed and loss-framed messages on RST traits has tended to rely upon the earlier version of the RST theory (see chapter 3). While these findings have been consistent with RST based expectations (i.e., those with stronger BAS traits were more likely to accept gain-framed messages, while those with stronger original BIS traits were more likely to accept loss-framed messages, Heavey & Dolan, 2013; Mann et al., 2004), further research is required to examine the revised RST traits in this context. Thus, Study 2 applied measures of Gray and McNaughton's revised RST traits to assess their influence upon processing of persuasion effects of a range of gain-framed and loss-framed road safety messages and thus, extend on this previous research. Further, given that previous research has focused upon assessing the higher-order level of the RST traits (e.g., Kaye et al., 2013; Van 't Riet et al., 2011), Study 2 examined the underlying components of the BAS and the FFFS.

Australian road safety messages have typically focused on the physical threats associated with risky driving behaviour. However, previous research has reported that these threat-based messages may only be effective for some young drivers, particularly young female drivers (e.g., Goldenbeld et al., 2008). Similarly, it is plausible that young drivers who are more sensitive to reward, for example, may be one subgroup who are not persuaded by these physical threat-based messages. Considering that these higher reward sensitive individuals are more likely to report a higher number of traffic violations, compared to those who are less sensitive to rewards (e.g., Constantinou et al., 2011; Scott-Parker et al., 2012), they represent a target population for alternative approaches to road safety message design. RST, for instance, would predict that such individuals may instead be more persuaded by gain-framed/ positive road safety messages. Study 2 therefore extended upon previous road safety research by examining the extent to which individual differences in reward and punishment traits, in conjunction with gain versus loss-framing, influence the processing of anti-speeding messages and subsequent message acceptance.

Processing of mixed message cues was also examined via the presentation of a social loss-framed message, designed to highlight the negative consequences associated with speeding behaviour (designed to activate the FFFS) and a motor vehicle message that promoted a high performance vehicle, presumed to activate the BAS. To the best of the author's knowledge, no published research in the health communication field has examined the revised BIS in relation to information processing and acceptance of mixed cues. Therefore, these stimuli were designed to create goal-conflict between avoiding the potential negative consequences of speeding behaviour that was advocated in the road safety messages versus approaching the opportunity to drive a vehicle that was capable of reaching high speeds (the latter message presented in the motor vehicle message).

7.2.1 Message processing

To assess processing of the gain-framed and loss-framed anti-speeding messages and the motor vehicle message, long-term repetition priming was employed. Chapter 5 discussed how individuals are quicker to respond to repeated word stimuli than to words which have not been repeated (e.g., Bentin & McCarthy, 1994), with the long-term repetition priming effects evident after short-lags (i.e., seconds/ minutes; e.g., Dannenbring & Briand, 1982) and long-lags (i.e., up to a couple of days; Scarborough et al., 1977). Further, the repetition priming effect has been shown to occur across various situations such as, individual presentation of words (e.g., Dannenbring & Briand, 1982) and sentences (e.g., Lowder et al., 2013). In Study 2, participants were required to read one of the four anti-speeding road safety messages (and the motor vehicle message, in the mixed message cue condition) on a computer screen, prior to completing a lexical decision task (LDT), that contained repeated word stimuli (i.e., 12 words from each message condition). Based on the repetition priming literature (see chapter 5), participants should demonstrate quicker reaction times (RTs) to the repeated message words compared to words only included for the first time in the LDT.

7.2.2 Lexical Decision Task

Given that a large number of repetition priming studies have used the LDT to assess RTs to word stimuli (e.g., Albrecht & Vorberg, 2010; Dannenbring & Briand, 1982; Scarborough et al., 1977; see chapter 5), a word/ non-word LDT was used in Study 2 to assess message processing. The LDT involves participants responding as fast and as accurately as possible as to whether a presented letter string represents a word or a pseudoword (i.e., a pronounceable non-word). Pseudowords were created by changing one letter from the current word stimuli (e.g., word to wrrd). The participants' correct RTs to the words previously presented as part of the messages were analysed to assess differences in cognitive word processing and faster RTs to correct word responses were taken to reflect greater initial attention and processing of the initial message on the screen.

Message Word stimuli. Each word list consisted of 12 words from each of the physical messages, social messages, and motor vehicle message (i.e., a total of 36 word stimuli; see chapter 6). The 36 filler words that best matched the arousal and valence ratings of the road safety and vehicle message words (Studies 1a and 1b) were included in the LDT.

Non-word stimuli. A non-word generation program (WordGen; Duyck, Desmet, Verbeke, & Brysbaert, 2004) was used to create pseudowords by replacing one letter from the current message word stimuli and from the corresponding filler words. To ensure that the non-words had a similar orthographic structure to the word stimuli, a vowel was used to replace a vowel and a consonant was used to replace a consonant. With the exception of seven words,[29] the first and last letters in the message and filler word stimuli remained the same when creating the corresponding non-word stimuli. Tables 7.1 and 7.2 present the non-word stimuli and corresponding word stimuli included in the road safety messages and motor vehicle message, respectively.

Past research has also suggested that neighbourhood size and bigram frequency may influence participants' RTs to non-word stimuli (see Duyck et al., 2004; Keuleers & Brysbaert, 2010, for discussions on creating appropriate non-words). Neighbourhood size refers to the number of additional words that can be created by changing one letter in an existing word (Duyck et al., 2004). In terms of non-words, neighbourhood size is used to assess how closely a non-word is related to a word (i.e., non-words that have higher neighbourhood sizes are more closely related to words than non-words with lower neighbourhood sizes). Bigrams are the number of letter pairs that are presented together in words (e.g., the word 'list' contains three bigrams, li, is, and st). Non-words with a higher bigram frequency are more closely related to words than non-words with a lower bigram frequency and thus, it is important to control for bigram frequency in lexical decision tasks. Therefore, neighbourhood size and bigram frequency of the non-words were controlled between the message non-word lists. Of note, there were no significant differences between the neighbourhood size and bigram frequency of the non-words between the three message conditions (see Tables 7.3 and 7.4).

[29] Seven words included in the LDT consisted of three letters. Since replacing a middle letter with a vowel in these words would still represent a word (e.g., p<u>u</u>t) or alternatively, would not be considered as an appropriate pseudoword (i.e., a pronounceable non-word), these seven words either had the first or last letter changed.

Table 7.1

Road Safety Message Word and Non-word Stimuli

Physical messages			
Physical message words	Physical message non-words	Physical filler words	Physical filler non-words
each	eath	easy	eacy
year	yoar	hand	hund
australia	ausyralia	singapore	sinyapore
people	peoble	father	farher
obey	orey	rank	rark
chance	chasce	change	chalge
protect	prodect	forgive	fortive
one	ose	any	acy
posted	possed	lounge	lounce
number	nomber	dinner	dincer
physical	plysical	confused	conrused
sustain	sushain	inspect	inspact
Social messages			
Social message words	Social message non-words	Social filler words	Social filler non-words
choose	choese	decide	dekide
friend	friand	family	fasily
car	cer	dad	dah
showing	shoning	weather	weacher
really	reanly	little	luttle
care	cabe	hope	hofe
safety	sakety	spring	spling
feel	fiel	must	munt
comfortable	comfoptable	responsible	ressonsible
put	pul	ask	asy
being	beang	woman	wogan
best	beft	real	reil

Table 7.2

Motor Vehicle Message Word and Non-word Stimuli

Motor vehicle message			
Vehicle message words	Vehicle message non-words	Vehicle message filler words	Vehicle message filler non-words
achieve	acheeve	applied	apphied
exceeds	expeeds	compile	commile
vehicle	vehacle	journey	joulney
powered	powired	immense	imsense
engine	engane	market	marlet
reaches	reashes	reflect	redlect
top	tok	hot	hof
street	streit	answer	ansler
permitted	perwitted	entertain	eentertain
test	tect	list	lipt
today	togay	house	hoose
all	aly	get	gek

Table 7.3

Neighbourhood Size and Bigram Frequency Statistics for the Non-word Message Word Stimuli

Variable	*M (SD)*	*t*	*p*	95% CI
Neighbourhood size				
Social non-words	3.54 (2.96)			
Physical non-words	3.31 (2.06)	0.23	.819	-1.83, 2.30
Social non-words				
Vehicle non-words	3.31 (3.73)	0.18	.863	-2.50, 2.96
Physical non-words				
Vehicle non-words		< 0.01	1.00	-2.44, 2.44
Bigram frequency				
Social non-words	10300.62 (6572.72)			
Physical non-words	10241.38 (3760.68)	0.03	.978	-4275.46, 4393.912
Social non-words				
Vehicle non-words	10277.69 (5325.53)	0.01	.992	-4819.44, 4865.29
Physical non-words				
Vehicle non-words		-0.02	.984	-3768.22, 3695.61

Note. CW = CI = Confidence Interval

Table 7.4

Neighbourhood Size and Bigram Frequency Statistics for the Non-word Filler Word Stimuli

Variable	*M (SD)*	*t*	*p*	95% CI
Neighbourhood size				
Social filler non-words	3.54 (2.44)			
Physical filler non-words	3.08 (2.53)	0.47	.640	-1.55, 2.47
Social filler non-words				
Vehicle filler non-words	3.08 (2.36)	0.49	.628	-1.48, 2.40
Physical filler non-words				
Vehicle filler non-words		< 0.01	1.00	-1.98, 1.98
Bigram frequency				
Social filler non-words	9814.54 (7593.60)			
Physical filler non-words	10857.38 (5721.83)	-0.40	.696	-6485.44, 4399.74
Social filler non-words				
Vehicle filler non-words	9762 (6855.16)	0.02	.985	-5803.43, 5908.51
Physical filler non-words				
Vehicle filler non-words		0.44	.662	-4015.95, 6206.72

Note. CW = CI = Confidence Interval

7.3 Aims and Hypotheses

There were three overarching aims for Study 2: (i) to assess if individual differences in reward and punishment sensitivities influenced young drivers' processing biases of content presented via gain-framed and loss-framed anti-speeding messages (as assessed via a computerised LDT); (ii) to examine if these processing differences would influence subsequent message acceptance ratings (as assessed via self-report ratings of message effectiveness, attitudes, behavioural intentions, and actual behaviour);[30] (iii) to induce BIS activation to enable examination of its influence on processing and persuasive outcomes. This final aim was operationalised by exposing a subsample of young drivers to a loss-framed road safety message (emphasising the negative consequences of speeding behaviour; designed to activate the FFFS) and a high performance motor vehicle message (designed to activate the BAS). Four key hypotheses were generated from these research aims.

As discussed in chapter 2 (section 2.2.3), the BAS is activated by reward stimuli, and individuals with a stronger BAS are more sensitive to cues of reward (e.g., gain-framed messages) than those with a weaker BAS. By contrast, the FFFS is activated by punishment stimuli and individuals with a stronger FFFS are more sensitive to cues of punishment (e.g., loss-framed messages) than those with a weaker FFFS (Gray & McNaughton, 2000). From these basic tenets, three key predictions followed, namely that:

H.1. Individuals with a stronger BAS would demonstrate a greater cognitive bias towards the content presented via the gain-framed messages, compared to individuals with a weaker BAS. Further, these individuals would be more likely to accept these messages (as measured by subsequent ratings of message effectiveness, attitudes, behavioural intentions, and message compliance).

[30] From this point forward the term 'message compliance' will be used when referring to participant's self-reported actual behaviour.

H.2. Individuals with a stronger FFFS (compared to those with a weaker FFFS) would demonstrate a greater cognitive bias towards the content presented via the loss-framed messages. It was further predicted that greater processing bias would predict greater acceptance and compliance for that message frame.

H.3. Stronger BAS would predict greater processing, acceptance and compliance of the physical gain-framed message compared to the physical loss-framed message. Similarly, it was anticipated that individuals with a stronger FFFS would show greater processing, acceptance and compliance of the physical loss-framed message than the physical gain-framed message. Further, it was hypothesised that this finding would be replicated for the social gain-framed and loss-framed messages.

The BIS is activated when conflict occurs between the BAS and the FFFS (see chapter 2, section 2.2.3). Such conflicts may arise when individuals are exposed simultaneously to a reward cue that results in the activation of the BAS and to a punishment cue that results in the activation of the FFFS (Corr, 2008). To potentially create goal conflict, participants were exposed to a motor vehicle message that promoted a high performance vehicle (BAS) and a social loss-framed message that highlighted the negative consequences that speeding behaviour may have for the participant and for their family and friends (FFFS). For those exposed to the mixed message cues (i.e., social loss-framed and motor vehicle message) it was predicted that (H.4.):

a) Individuals with a stronger BIS (compared to those individuals with a weaker BIS) would inhibit their responses, as demonstrated by slower RTs to the words from these message stimuli (i.e., social-loss and motor vehicle message).

b) Individuals with a stronger BIS would respond slower to words from the loss-framed message compared to their counterparts who were only exposed to the social loss-framed message.

c) Individuals with a stronger FFFS (compared to those with a weaker FFFS) would report greater acceptance of the social loss-framed message. Similarly, it was expected that individuals with a stronger BAS in this condition would show greater acceptance of the vehicle message than those individuals with a weaker BAS.

7.3.1 Secondary hypotheses

An additional two hypotheses were generated to further examine personality effects on risky driving behaviours and perceptual biases (i.e., optimism bias and the Third-person Effect [TPE]). Previous research has reported that personality characteristics may influence risk taking behaviour (see chapter 4, section 4.6). Of particular interest to the current research, individual differences in reward sensitivity may influence self-reported speeding behaviour. Specifically, research has found that individuals who are more sensitive to rewards are more likely to partake in risk taking behaviour compared to those individuals who are less sensitive to rewards (e.g., Castellá & Pèrez, 2004; Harbeck & Glendon, 2013). Theoretically, individuals with stronger BAS have a strong desire to approach rewarding cues. In the context of speeding behaviour, young drivers may perceive speeding to be exciting and thrilling or, alternatively, may be rewarded by their peers for partaking in this risky driving behaviour. One hypothesis, therefore, tested whether individual differences in BAS influenced speed related driving behaviours. Specifically,

H.5. It was predicted that individuals who were more sensitive to rewards would report greater engagement in risky driving behaviour than those individuals who are less sensitive to rewards.

Perceptual biases, such as optimism bias and the TPE, have been found to reduce the persuasiveness of road safety messages, with past research reporting that young drivers may be more susceptible to perceptual biases than other age groups (see chapter 4, section 4.5). Of particular interest to Study 2, individual differences in reward and punishment traits may also influence perceptual biases. Theoretically, individuals with stronger BAS may have unrealistic positive expectations regarding their own driving skills and behaviour than those with a weaker BAS and, thus, perceive themselves to be more likely to experience positive outcomes than others (i.e., greater optimism bias; Weinstein, 1980). Those individuals with stronger BAS traits (compared to those with weaker BAS traits) may perceive themselves to be less vulnerable to the potential negative consequences such as driving related crashes because of these biases towards positive expectations and thus, may be more likely to participate in risky speeding behaviour. One hypothesis was tested to examine whether individual differences in BAS influenced optimism bias. It was predicted that:

H.6. Individuals with stronger BAS traits would demonstrate greater driving-related optimism bias (i.e., perceive themselves to be more skilful, safer, more experienced, less risky, and less likely to be involved in a speed-related crash compared to same aged peers) than those with weaker BAS traits.

Independent of personality, a further three hypotheses were generated to examine gender effects on risky driving behaviours and perceptual biases. Previous research has reported that young male drivers are more likely to report speeding behaviour compared to young female drivers (Harrè et al., 1996; Horvath et al., 2012a).

H.7. It was predicted that male drivers would report higher speed related risk taking behaviours compared to female drivers.

As discussed in chapter 4 (section 4.5.1), young male drivers may be more susceptible to perceptual biases than young female drivers. Further, research has also found that male and females respond differently towards messages that differ in type and frame (e.g., Goldenbeld et al., 2008; Lewis et al., 2008b, 2009). Specifically, this previous research has reported that male drivers may be more persuaded by gain-framed messages, while female drivers may be more persuaded by messages that contain physical threats. However, Study 1c's findings found that male drivers were more inclined to report the social loss-framed message to be persuasive, while female drivers expressed negative reactions towards this message. Two hypotheses were generated to examine potential gender effects on perceptual biases:

H.8. As per previous research findings (e.g., Gosselin et al., 2010; Harré & Sibley, 2007), it was predicted that male drivers would demonstrate more driving related optimism bias than female drivers.

H.9. It was predicted that male drivers would perceive other people (i.e., third persons) would be more persuaded by the physical loss-framed message, while female drivers would perceive that the physical loss-framed message would influence themselves more so than others.

Due to the differences in findings between previous research (e.g., Goldenbeld et al., 2008; Lewis et al., 2008b, 2009) and those from Study 1c (see chapter 6, section 6.12.2), no specific hypothesis was generated for the social loss-framed condition. Instead, Study 2 further explored the potential effects of gender on the persuasiveness of the social loss-framed message (in terms of the TPE).

7.4 Method

7.4.1 Participants

A total of 142[31] university students (104 female; *M*age = 19.94 years, *SD* = 2.63) were recruited via QUT's School of Psychology and Counselling online recruitment system for first year psychology students and via email.[32] Participants were required to be aged between 17 and 25 years of age, hold a current provisional or open Australian driver's licence, speak English as their first language and have normal/ corrected to normal vision. Eight participants

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[31] The general power analysis program, GPower 3.0.10, was used to calculate the required sample size (Medium effect size, $f^2 = 0.15$ was calculated for 5 IVs; $\alpha = 0.05$). The results showed that a sample of 138 individuals would be required to detect a R^2 deviation from zero to 0.8, with a critical $F = 2.28$.

[32] QUT student and staff mailing lists.

did not meet these requirements and were excluded from further analysis: five participants reported holding a learners permit, two participants reported English as their second language and one participant did not meet the age requirements. Additionally, one participant was excluded due to technical problems with the LDT. Thus, the final sample comprised 133 participants. Of those, 101 participants received partial course credit of 2% towards their final grade and the remaining participants (non-psychology first year students) received a $20 shopping voucher.

Of the 133 participants, 114 (85.7%) identified with a Caucasian/ European background, eight (6%) identified with Asian, two (1.5%) identified with Caucasian/ Asian, three (2.3%) identified with Polynesian, and one participant each (3.8%) identified with Aboriginal and/ or Torres Strait Islander, Greek, Indian, and Egyptian. One person did not report their ethnic background. One hundred (75.2%) participants reported a high school secondary certificate as their highest level of education, 21 (15.8%) participants had achieved a Cert III-IV, diploma, or advanced diploma, while the remaining 12 (9%) participants had reported holding a university undergraduate degree. The majority of participants (*n* = 128; 96.2%) were current full-time students while the remaining five (3.8%) participants were studying part-time. For employment, 68 (51.1%) participants reported working on a causal basis, 26 (19.5%) reported working part-time, five (3.8%) were full-time employees, while the remaining 34 (25.6%) participants were unemployed students.

On average, participants first received their driver's licence at 16.81 years (*SD* = 0.93). Of the 133 participants, 45 (33.8%) currently held an open/ unrestricted licence, 46 (34.6%) held a provisional 1 restricted licence, while 42 (31.6%) reporting holding a provisional 2 restricted licence.[33] Twenty-two (16.5%) participants reported receiving at least

[33] A provisional 1 drivers' licence is received upon passing a driving test. Young drivers are eligible for a provisional 2 licence after they have held a provisional 1 licence for one year and are eligible for an open drivers' licence after holding a provisional 2 licence for two years (Queensland Government, 2013).

one traffic fine/ loss of points in the previous 12 months, with the majority (*n* = 15) self-attributed to speeding behaviour.[34] Seventeen (12.8%) participants reported involvement in a crash in which they were the driver and five (3.8%) in a crash in which they were the passenger. The majority of participants (*n* = 78; 58.6%) reported regularly driving 1-10km/hr over the posted speed limit, with six (4.5%) drivers stating that they regularly drive 10-20km/hr over the posted speed limit, suggesting that the road safety messages were relevant to this sample of young drivers. These statistics are less than those reported in previous government reports, which found that 80% of young drivers reported regularly driving 1-10km/hr over the posted speed limit (see Australian Institute of Family Studies, 2005). The remaining participants (*n* = 49; 36.8%) reported regularly driving at or below the recommended posted speed limit.

7.4.2 Design

Participants were randomly allocated to one of five experimental conditions.[35] A between-groups designed was used to prevent relative judgements and, thus, allow each message (with the exception of the mixed message cue condition which comprised both the social loss-framed message and motor vehicle message) to be considered on its own merits. Twenty seven participants were each allocated to one of four anti-speeding message conditions (i.e., physical gain-framed, physical loss-framed, social gain-framed, and social loss-framed) and 25 participants were allocated to the mixed message condition. The dependent variables consisted of message processing (i.e., RTs to message words), message acceptance (i.e., self-reported message effectiveness, attitudes, and behavioural intentions) and a message compliance measure.

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[34] Four of these participants had received two fines, one of which had received two speeding fines.

[35] Excel calculation: =CHOOSE (INT (RAND()*5, “PG”, “PL”, “SG”, “SL”, “AD”).

7.4.3 Materials

7.4.3.1 Lexical Decision Task. The LDT comprised 36 target words (i.e., 12 words common to both the physical messages, 12 words common to both the social messages, and 12 words taken from the motor vehicle message) and 36 corresponding filler words matched on frequency, length, word valence, and word arousal to the words in the messages. For each of the target and filler words, a pseudoword was created and included as non-word stimuli in the LDT. Thus, a total of 144 trials were included in Study 2. Trials were presented in one block and were randomised. Participants were instructed to direct their attention towards a fixation point that appeared for 500ms and respond as fast and as accurately as possible if a series of letter strings formed a word (by pressing ‘1’ on the computer keyboard) or a non-word (by pressing ‘2’ on the computer keyboard). The letter strings remained on the computer screen until the response was selected, with no maximum exposure time (see Figure 7.1). Prior to starting the main experiment, participants completed six practice word and non-word trials.

Mean RTs were calculated from participants’ correct ‘word’ (1) responses to message word stimuli, after applying cut-off filters of < 300ms and > 1000ms in E-prime to exclude excessively short and long RTs. Similar accuracy levels were found for the three message word lists; words in the social messages (98%, SD = 0.07), words in the physical messages (99%, SD = 0.03) and words in the motor vehicle messages (97%, SD = 0.05). Faster RTs were taken to indicate greater initial word processing from the earlier presentation of the message, consistent with relevant network models reviewed in chapter 5 (see section 5.2).

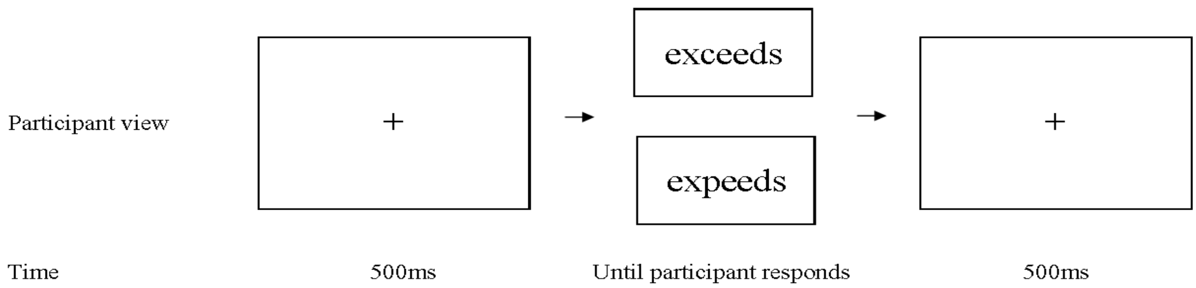

Figure 7.1. An example of a LDT trial. Word and non-words were presented to participants in lower case Courier New 18 point font on a white background.

7.4.3.2 Personality self-report and behavioural measures.

Self-report measures. Three self-report measures assessed RST traits: Carver and White's (1994) BIS/ BAS Scales, the Jackson-5 (2009) Scales and the Corr and Cooper RST-PQ (2013). As discussed in chapter 2, section 2.4, the BIS/ BAS Scales were developed to measure sensitivities of Gray's original conception of BIS and BAS and despite extensive changes to the RST, these scales are still widely used as a measure of Gray and McNaughton (2000) revised traits. However, Carver and White's BIS scale combines both fear and anxiety responses and thus, measures developed after the revisions to the theory may be more suitable to assess the redefined BIS and FFFS (e.g., Smillie et al., 2006b). The Jackson-5 Scales and Corr and Cooper's RST-PQ were designed to measure the revised RST traits and thus, differentiate between fear and anxiety responses. However, these two scales have currently received limited empirical attention and further research is required to evaluate these measures of the revised RST. The current research program included the BIS/ BAS Scales, the Jackson-5 Scales, and the RST-PQ to more comprehensively assess the traits linked to the BAS, the FFFS and the BIS. Higher scores on each scale indicate greater sensitivity of that system. Mean scores were applied to all personality scales in the current program of research to enable interpretation with reference to its original scale value and allow for comparisons to other scales (e.g., message acceptance measures) used in Study 2.

Carver and White's BIS/ BAS Scales. Using a 4-point Likert Scale (1 = *strongly disagree*, 4 = *strongly agree*), 7 items comprised the original BIS scale (e.g., "I feel worried when I think that I have done poorly at something") and 13 items comprised the original BAS scale. The BAS scale is further divided into three scales: BAS: Reward Responsiveness (5 items; e.g., "When I'm doing well at something, I love to keep at it"), BAS: Drive (4 items; e.g., "If I see a chance to get something I want, I move on it right away") and BAS: Fun Seeking (4 items; e.g., "I often act on the spur of the moment"). FFFS and BIS scale scores were also computed using a new recommended scoring method (i.e., 3 BIS items to represent FFFS: Fear and the remaining 4 BIS items to represent BIS: Anxiety; see Heym, Ferguson, & Lawrence, 2008) to incorporate the theoretical changes made to these systems. In the current sample, Carver and White's (1994) BIS/ BAS Scales were all shown to have acceptable internal consistency (i.e., BIS α = .76, BAS: Reward Responsiveness α = .79, BAS: Drive α = .87, and BAS: Fun Seeking α = .79), while the Heym et al. scored 3-item FFFS: Fear and 4-item BIS: Anxiety scales showed slightly lower internal consistency (α = .68 and α = .65, respectively).

Jackson-5 Scales. Using a 5-point Likert Scale (1 = *strongly disagree*, 5 = *strongly agree*) a total of 30 items (6 items for each behavioural response), the Jackson-5 Scales (2009) assess the revised RST traits (e.g., BAS: "I like to do things which are new and different" α = .70[36], BIS: "I aim to do better than my peers" α = .69, Fight: "I would fight back if someone hit me first" α = 75, Flight: "If approached by a suspicious stranger, I run away" α = .66, and Freezing: "If something very bad was just about to happen to me, I would just stop" α = .68). The Fight, Flight, and Freezing scales were also combined to provide an overall FFFS score (α = .76). As indicated above, only two of the six scales showed acceptable internal consistency ($\alpha \geq .70$; Cronbach, 1951) in Study 2, while the BIS, Flight,

[36] The alphas presented in this section are from Study 2.

and Freezing scales yielded Cronbach's alphas that were slightly below the recommendations ($\alpha \geq .70$). However, given that previous research has reported similar reliabilities (e.g., Harnett, Loxton, & Jackson, 2013) and the statistics were generally close to the recommended cut-off, all scales were retained in the data analyses as measures of the revised RST components.

Corr and Cooper's RST-PQ Scale. Corr and Cooper's (2013) RST-PQ has recently been developed as an alternative revised RST measure. Using a 4-point Likert Scale (1 = *Not at all*, 4 = *Highly*), it consists of 80 items to assess the main three RST systems: 10 FFFS items (e.g., "I would be frozen to the spot by the sight of a snake or spider"), 23 BIS items (e.g., I am often preoccupied with unpleasant thoughts") and 32 BAS items. The BAS scale comprises four scales: BAS: Reward Interest (7 items; e.g., 'I regularly try new activities just to see if I enjoy them"), BAS: Goal-Drive Persistence (7 items; e.g., "I put in a big effort to accomplish important goals in my life"), BAS: Reward Reactivity (10 items; e.g., "Sometimes even little things in life can give me great pleasure"), and BAS: Impulsivity (8 items; e.g., "I think that I should 'stop and think' more instead of jumping into things too quickly"). An additional two scales are also provided: Panic (6 items; e.g., "My heart starts to pump strongly when I am getting upset") and Defensive Fight (8 items; e.g., "I usually react immediately if I am criticized at work"). All scales showed acceptable internal consistency in the current study (i.e., BAS: Reward Interest $\alpha = .76$, BAS; Goal-Drive Persistence $\alpha = .83$, BAS: Reward Reactivity $\alpha = .79$, FFFS $\alpha = .77$, BIS $\alpha = .92$, Panic $\alpha = .76$, and Defensive Fight $\alpha = .76$), with Impulsivity slightly under the recommended alpha at .69. However, since the Impulsivity scale was only slightly below the recommended alpha of .70, it was decided to proceed with this scale. Similar internal consistencies for these scales were reported in Corr et al. (2013), although the BAS: Reward Interest scale in the current sample yielded a slightly lower alpha than reported in Corr et al. (i.e., $\alpha = .84$).

Behavioural measures. Two computerised behavioural measures were included to further assess the RST traits. The CARROT (Powell et al., 1996)[37] and the Q-Task (Newman et al., 1997) are two objective performance-based measures that have been successfully used to assess the BAS and the original BIS, respectively (Corr & McNaughton, 2008).

The Card Arranging Reward Responsivity Objective Test (CARROT; Powell et al., 1996). The computerised CARROT consisted of four trials. The first trial required participants to sort 60 cards into three piles based on the presence of one of three digits (i.e., 1, 2, or 3; each card consists of 5 digits) as quickly as possible (this time was used for the subsequent trials). For the second trial (i.e., experimental non-reward trial), participants were again required to sort the cards into piles as quickly as possible, this time within a given time frame determined by their first trial. In the third trial (i.e., experimental reward trial), participants were provided with a monetary incentive of 20 cents for every five cards that are sorted into correct piles within the same time limit. Participants were not aware of this incentive until the third trial instructions and were provided with their total awarded monetary value at the end of the testing session. Finally, the fourth trial (i.e., experimental non-reward trial) replicated the second trial (designed to control for practice and fatigue effects). On completion, the total number of sorted cards in the third reward trial was subtracted from the average number of cards sorted in trials two and four (non-reward trials) to calculate a CARROT score (Powell et al., 1996). Thus, a greater CARROT score represented higher reward sensitivity (i.e., faster sorting in the presence of rewards).

Q-Task (Newman et al., 1997). The Q-Task consisted of two phases: phase 1 included 150 trials and phase 2 included 145 trials. Phase 1 was designed to condition participants to avoid responding to the letter Q, while phase 2 (i.e., the test condition) was used to obtain a

[37] The CARROT is typically administered in person (see Powell et al., 1996). To the best of the author's knowledge, Study 2 is one of the first studies to use a computerised version of the CARROT.

performance score that measured avoidance behaviour. Phase 1 required participants to respond as quickly and as accurately as possible by pressing the space bar on the computer to letter strings for which the letter Q was absent (50% of trials). Participants completed the first 75 trials and were provided with a short rest break of 2 minutes before completing the final 75 trials. Participants who responded correctly to the letter string received 3 points and feedback of "Correct: You win 3 points", while incorrect responses received a deduction of 5 points and feedback of "Wrong: You lose 5 points".

In Phase 2, participants were presented with a set of four letters (40% of trials; Go trials) or three letters and one number (No Go trials). The letters and numbers were presented to participants in a 2 x 2 matrix. Participants were only required to respond by pressing the space bar on the computer when the four letters were presented in the matrix (i.e., Go trials; no response was required for the NoGo trials of three letters and one number). The letter Q appeared in 50% of the four letter string trials. Consistent with previous studies which have used the Q-Task (e.g., Kambouropoulos & Staiger, 2004), no rest break was provided to the participants whilst completing the 145 trials in phase 2. As per phase 1, 3 points were awarded for correct responses and 5 points deducted for incorrect responses. Consistent with previous research (see Loxton & Dawe, 2007), the total Q-Task score (i.e., Q-present trials minus Q-absent trials) was calculated based upon the mean RTs to the first 15 letter strings that contained Q (Q-present) and the first 15 letter strings without Q (Q-absent) on the correct trials in phase 2. Slower responses in the Q-present trials (compared to the Q-absent trials) reflected greater avoidance/ inhibition to punishment cues, in this case, the letter Q.

7.4.3.3 Perceptual Bias Scales.

Driving-related Optimism Bias Scale. Driving-related optimism bias was assessed by using five of the 10 items that were previously used by Harrè et al. (2005) to assess self-enhancement biases. Items are scored on a 7-point Likert Scale (1 = *much less*, 7 = *much* *more*) and, for each item, participants were asked to make self-other comparisons. Specifically, participants were asked "Compared to a typical young driver"..."How skilful do you think you are as a driver", "How safe do you think you are as a driver", "How experienced do you think you are as a driver", "How risky do you think you are as a driver" and, "Do you think that you are more or less likely to be involved in a speeding accident while you are the driver". Higher scores on the first three items and lower scores on the final two items indicate greater self-enhancement bias. Only five of the 10 items used by Harrè et al. (2007) were used but, the total scale of these five items showed acceptable internal consistency, (α = .72).

Third-person Effect. One item assessed the TPE. Using a 9-point semantic scale, participants were asked to rate if (1) 'the message was intended for people like me', to (9) 'this message was intended for others'. This item was previously used in Walton and McKeown (2001) to assess young drivers' perceptions towards road safety anti-speeding advertising slogans.

7.4.3.4 Risk Taking Behaviour Scale. The 6-item Risk Taking Behaviour scale (Ulleberg & Rundmo, 2003) was used to assess frequency of speeding behaviour pre and post message exposure. Participants were asked to respond, using a 5-point Likert Scale (1 = *Never,* 5 = *Very often*), how well the statements described their current driving behaviour. The items included: "Exceed the speed limit in build-up areas (more than 10km/h)", Exceed the speed limit on country roads (more than 10km/h)", Overtake the car in front when it is driving at the speed limit", "Drive too close to the car in front", "Bend the traffic rules in order to get ahead in traffic", and "Ignore traffic rules in order to get ahead in traffic". Higher scores on these items indicate greater risk taking behaviour. On the follow-up questionnaire (post-message exposure), all items were altered to measure participants' risk taking behaviour since viewing the message (e.g., "Exceed the speed limit in build-up areas (more than

10km/h)" was changed to "In the past week"... "I have exceeded the speed limit in build-up areas (more than 10km/h)"). The Risk Taking Behaviour Scale showed acceptable internal consistency in the current study, both pre (α = .77) and post (α = .79) message exposure.

7.4.3.5 Message acceptance measures. Four message acceptance scales assessed message effectiveness, attitudes, behavioural intentions, and message compliance. These scales were modified from previous measures of message acceptance (see Dillard & Peck, 2001; Shen & Dillard, 2007), with the message effectiveness, attitudes, and behavioural intention scales used as measures of message acceptance in Kaye et al. (2013). All scales were shown to have acceptable internal consistency in the current study (i.e., message effectiveness α = .87 (r = .783, p < .001), attitudes α = .87, behavioural intentions α = .79, and message compliance α = .82). Higher scores on these scales reflect greater message acceptance.

Message Effectiveness Scale. A 7-point Likert scale (1 = *strongly disagree,* 7 = *strongly agree*) was used to assess the participants' perceived effectiveness of the vehicle message. This measure comprised 2 items; "I found the message convincing" and "I was persuaded by the message".

Attitude Scale. A 3-item scale was used to assess participant attitudes toward the messages. Items consisted of "The message was consistent with my beliefs", "I believe the message to be important", and "I felt strongly towards the position of the message". Participants rated each item on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*).

Behavioural Intentions Scale. This 5-item scale assessed participants' intentions towards complying with the road safety messages. Using a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*) items consisted of "I intend to act in a way that is consistent with the message", "A goal of mine would be to act in a way that is compatible with the message”, “I am going to make an effort to alter my behaviour in accordance with the message”, “I intend to obey the speed limits when I am driving”, and “I intend to monitor my speed”.

Message Compliance Scale. Consistent with previous self-report measures of driving behaviour (e.g., Tay & Watson, 2002), the 5-items used to assess behavioural intention were altered to measure message compliance, at time 2. For example, “I intend to act in a way that is consistent with the message” was changed to “I acted in a way that was consistent with the message” in the follow-up questionnaire. Participants were required to rate each item on a 7-point Likert Scale (1 = *strongly disagree*, 7 = *strongly agree*), with higher scores representing greater message compliance.

7.4.3.6 Motor vehicle message acceptance measures. Three scales assessed participants’ acceptance of the motor vehicle message. The attitude and vehicle effectiveness scales were designed to evaluate participants’ acceptance of the motor vehicle message. A Goal Scale was developed to assess participants’ goals in relation to this message (i.e., assess an individual’s desire to be able to drive the vehicle presented in the message).

Motor Vehicle Message Attitude Scale. Using a 7-point semantic differential scale, participants rated the vehicle message on three word pairs, to assess attitudes towards this message: unpleasant/ pleasant, unfavourable/ favourable, and negative/ positive. These items were based on MacKenzie and Lutz’s (1989) attitude measure and showed acceptable internal consistency in the current sample (α = .94).

Motor Vehicle Message Effectiveness Scale. Vehicle message effectiveness was measured via 2-items, “I found the advertisement convincing” and “I was persuaded by this advertisement”. Participants rated each item on a 7-point Likert Scale (1 = *Strongly disagree*, 7 = *Strongly agree*). This scale showed acceptable internal consistency in the current study (α = 90) ($r = .822$, $p < .001$).

Goal Scale. Based on the findings of Study 1c and previous RST research (see Corr, 2008), a 6-item scale was purposely designed for the current study to assess participants' goals towards the motor vehicle message. Using a 7-point Likert Scale (1 = *strongly disagree*, 7 = *strongly agree*) the questions included, "A goal of mine would be to test drive the car in the advertisement", "I would get excited if I was able to test drive the car in the advertisement", "I have a desire to test drive the car in the advertisement", "Driving the car presented in the advertisement would be fun", "I hope to one day be able to drive the car in the advertisement" and, "I would find driving the car presented in the advertisement to be pleasurable". Higher scores on this scale represented stronger goals towards driving the vehicle presented in the message. The Goal Scale showed acceptable internal consistency in this sample (α = 93).

7.4.3.7 Manipulation checks. While one of the purposes of Studies 1a and 1b was to assess the validity of the manipulation of message frames and to check the arousal and valence ratings of individual message words, several changes were subsequently made to the message stimuli based on these findings prior to their use in Study 2 (see chapter 6, section 6.13). Specifically, the two physical messages were altered to remove the social cue elements that participants had referred to in the group discussions. Further, to improve the match of the individual words used in the physical and social messages on valence ratings, two words were changed in the physical messages (i.e., "risk" changed to "chance" and "severity" changed to "number") and two words were changed in the physical message word stimuli list (i.e., "event" was replaced with "chance" and "crash" was replaced with "protect"). To ensure that the messages were still functioning as intended in the new sample, three message manipulation checks (i.e., message framing, word arousal, and word valence) were included here. Finally, an additional measure was included to assess participants' arousal ratings for the overall messages.

Message frame. Using the following word pairs: disadvantage/ advantage, negative/ positive, and loss/ gain, a 7-point semantic differential scale was used to assess the validity of the message frame manipulation (gain vs. loss frame; Shen & Dillard, 2007). The message frame scale showed acceptable internal consistency in the current study (α = 93).

Message arousal. A 7-point semantic differential scale using the following word pairs: calm/ jittery, dull/ excited, and unaroused/ aroused was included to assess participants' subjective arousal ratings of the road safety messages and motor vehicle message in their entirety. The message arousal scale was shown to have acceptable internal consistency of (α = 73) in the current sample.

LDT stimuli arousal and valence ratings. Two 7-point semantic differential scales were used to assess perceived arousal and valence of each of the words from the messages that were included in the LDT stimuli list (1 = *low arousal*, 7 = *high arousal*; Aquino & Arnell, 2007 and *1 = negative*, 7 = *positive*), respectively.

7.4.4 Procedure

Participants completed the tasks independently on a computer (21.5″ screen size; 1400 x 900 screen resolution) in a quiet laboratory, in small groups of up to eight participants. Participants were randomly assigned to one of five message conditions: physical loss-framed, physical gain-framed, social loss-framed, social gain-framed and the mixed social loss-framed/ motor vehicle message condition. Participants first viewed the road safety message and/ or the motor vehicle message in the mixed cue condition, prior to completing the computerised LDT that included words taken from these messages. Participants were instructed to read the text carefully and click 'Enter' on completion of reading the message(s) to proceed to the next screen. The next screen included instructions for the LDT. The message was presented in the centre of the computer screen in 18 point Courier New font and remained on the screen until participants clicked 'Enter', with no maximum exposure time.

On completion of the LDT, participants then completed the self-report questionnaire that contained demographic and current driving behaviour questions, the optimism bias scale, the three personality measures,[38] road safety message and/ or motor vehicle acceptance measures, message and word arousal ratings and word valence ratings. Participants then completed the CARROT and the Q-Task. To reduce order and/ or fatigue effects, the CARROT and the Q-Task were counterbalanced such that half the participants completed the CARROT task first. Participants were then provided with the money earned during the CARROT task and informed that they would be emailed the online link to the follow-up questionnaire in one week's time.

One week later, participants were emailed a link to the follow-up questionnaire. In this questionnaire, participants were asked to report on their driving behaviour over the past week (e.g., number of hours and any driving fines/ loss of points), complete the Risk Taking Driving Behaviour scale, and complete the follow-up driving behaviour measure that was designed to assess acceptance of the previously viewed road safety message. Eighty percent of participants completed the follow-up questionnaire, with 71% of those participants completing the questionnaire within 14 days of receiving the online questionnaire link (average testing time between questionnaires was nine days).[39] Participants who completed the questionnaire after 15 days (n = 12) were removed from any follow-up analysis as one of the purposes of this study was to assess driving behaviour within two weeks of viewing the message. Similarly, seven participants who reported not driving between time 1 and time 2 were also removed from the follow-up analysis because actual driving behaviour and

[38] The presentation order of the three personality measures was counterbalanced to reduce order and/ or fatigue effects (i.e., The BIS/ BAS Scales, the Jackson-5 Scales and the RST-PQ were each presented first one-third of the time). There were no significant questionnaire order effects on demographic variables (e.g., age and gender) or on self-reported speeding behaviour (see Appendix B).

[39] Participants were sent a reminder email if the online questionnaire was not completed within five days of receiving the follow-up email.

consequently, message compliance could not be assessed. As such, 98 participants were included in the time 2 analyses that assessed post experiment risk taking driving behaviour and reported message compliance (see Figure 7.2 for an overview of the design for Study 2).

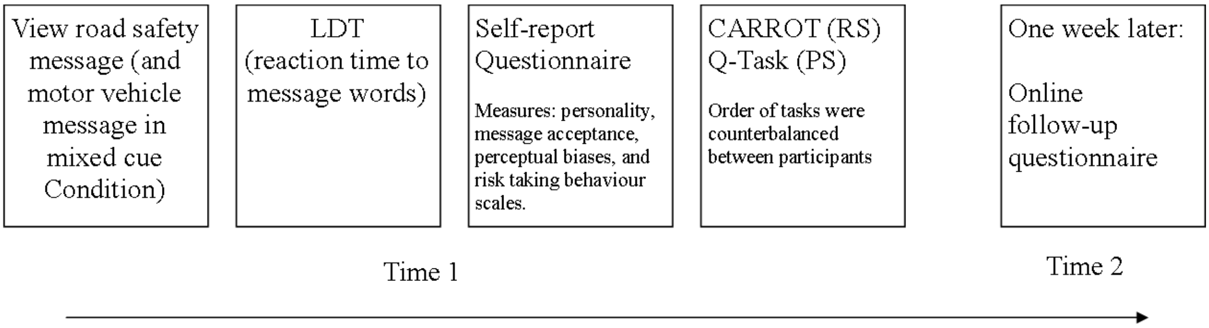

Figure 7.2. Overview of Study 2 design.

7.5 Results

The results are provided here in eight sections. The first five sections present the preliminary data screening, as well as manipulation and validity checks. Next, preliminary findings are presented of the RST traits and message acceptance measures, before the results of the main analyses (using correlations, mediations, and analyse of variance [ANOVA]) that examined the key research hypotheses are presented. Finally, the findings from the correlations and independent groups *t*-tests that were used to assess the influence of RST traits and message frame on perceptual biases and risky driving behaviour are presented.

7.5.1 Main analyses

For each of the RST traits and corresponding message conditions (i.e., BAS and gain-framed messages, FFFS and loss-framed messages, and BIS and mixed messages cues), preliminary correlations and mediation analyses were first conducted to examine the potential influence that individual differences may have had on message processing and subsequent message acceptance. Next, using the PROCESS method (www.afhayes.com; see also Hayes, 2013), the indirect effect was calculated using a bootstrap re-sampling of 5000 and was considered significant if zero was excluded from the 95% confidence intervals. Mediation is reported when the relationship between the independent variable (IV) and the dependent variable (DV) can be explained by a third variable, the mediator (i.e., MV; full mediation, in this case, message processing)[40] or when the relationship between the IV and the DV (message acceptance) is partially influenced by the MV, processing (i.e., partial mediation; Hayes, 2013).

A series of between-groups ANOVAs were then undertaken to test the potential effects of the individual RST traits on message processing and message acceptance, as a function of message frame (i.e., loss-framed and gain-framed). In the ANOVAs, condition was entered as the IV (loss-framed message and gain-framed message or in the case of the mixed cue condition, social-frame message and motor vehicle message) and RTs to corresponding message words and the message acceptance measures were entered separately as the respective DV in each analysis. The RST traits were entered separately (i.e., each analysis comprised of one RST trait) as the covariate variable (CV).[41] As recommended by DeCoster (2004), significant RST main effects and interactions were interpreted by using follow-up simple linear regressions. Partial eta squared and effect size *r* are reported as the measure of effect size for the simple linear regressions.

7.5.2 Additional analyses

A series of one-sample *t*-tests, independent groups *t*-tests, and correlation analyses were used to assess individual differences in perceptual biases and self-reported risky driving behaviour. Eta^2 is reported as the measures of effect size. To increase the chance of detecting

[40] As measured by RT to the message words.

[41] Since the RST personality traits are continuous variables, this method was used rather than median splits for the BAS, the FFFS, and the BIS traits.

any significant effects, the significant and approaching significant values were assessed at $p <$ .05 and $p \leq .10$, respectively, in all reported analyses.

7.5.3 Data cleaning

Missing data. Visual inspection of the data revealed that several values were missing at random on the RST scales, arousal rating scale, and valence rating scale only. The little MCAR test indicated that missing data were less than 5% and that the data were missing at random, χ^2 (83) = 70.10, $p = .843$. Missing cases were excluded from further data analyses.

Assumption checks and outliers.

Normality assumption. Normality was assessed both visually, via histograms, Q-Q plots, and P-P plots and statistically, via skewness and kurtosis output. All variables, with the exception of the Q-Task and the attitude scale, met the normality assumption. The total Q-Task score was negatively skewed (skewness statistic, -1.35) and had a positive kurtosis value (kurtosis statistic, 8.22), indicating a leptokurtic distribution. After removing the four outliers (three of those outliers were >2 *SD* above the mean and one was >3 *SD* above the mean), normality improved (skewness statistic, -0.01; kurtosis statistic, -0.12) and, as such these outliers were excluded from further data analyses. The attitude scale was negatively skewed (skewness statistic, -1.79), indicating that there were a large number of high scores and positive kurtosis (kurtosis statistic, 4.28). The skewness and kurtosis for the attitude scale were found to be the result of outliers. All other assumptions were met, unless stated.

Outliers. Univariate outliers were assessed via histograms, stem and leaf plots, and box plots, while Mahalanobis distance and Cook's distance were used to evaluate multivariate outliers. For the RST measures, the histogram revealed that one outlier (> 2 *SD* above the mean) was identified on each of the following scales: CW BAS: Drive, CW FFFS: Fear, CW BIS: Anxiety, CC Defensive Fight, Jackson's BIS, and the CARROT scores. Two outliers were identified on Jackson's Fight scale and three outliers on Jackson's BAS scale (>

2 *SD* above the mean). As previously stated, four outliers were identified and removed from the Q-Task scores because of a breach in normality. The results showed that Mahalanobis distance was $\chi^2(22) = 21.83$, $p < .001$, while Cook's distance was 0.09, indicating that these outliers on the RST measures had no major influence on the data analysis.

For the message acceptance scales, only the attitude scale scores included outliers. However, since removing these five outliers would remove all the lower attitude ratings and thus, meaningful data, it was decided that no outliers would be removed (all outliers were < 3 *SD* from the mean). Further, Mahalanobis distance of $\chi^2(5) = 5.68$, $p < .001$ and Cook's distance of 0.08 revealed that the multivariate outliers on the message acceptance scales would not influence the data analysis. One outlier was identified in the social mean RTs and two outliers were identified in the physical mean RTs. The results revealed that both Mahalanobis distance of $\chi^2(3) = 2.98$, $p < .001$ and Cook's distances of 0.01 indicated that there would be no major influence of outliers on the data.

7.5.4 Message manipulation checks

Message frame. A between-groups MANOVA was conducted to assess the effect of the message framing manipulations (gain- vs. loss-framed anti-speeding messages) on participants' mean ratings. Participants who viewed the loss-framed messages rated these as significantly more towards the disadvantage ($M = 3.65$, SD = 1.76), negative ($M = 2.89$, $SD = 1.83$), and loss-framed ($M = 3.59$, $SD = 1.83$) end of the continuum, than those that viewed the gain-framed messages. Participants who viewed the gain-framed messages rated them more towards the advantage ($M = 5.48$, $SD = 1.45$), positive ($M = 5.30$, $SD = 2.89$), and gain-frame ($M = 5.50$, $SD = 1.55$), $F(3, 104) = 17.50$, $p < .001$. These findings support the view that the messages were perceived by participants in the respective directions that had been intended.

Road safety message arousal. One-way between-groups ANOVAs were used to assess the extent of differences in perceived arousal values of the message stimuli between message conditions. The results showed that there were no significant differences between the mean arousal ratings of participants who viewed the loss-framed message and those who viewed the gain-framed messages (see Table 7.5). Further, there were no significant differences in mean arousal ratings between those participants who viewed the social message compared to those who viewed the physical message (see Table 7.6). Thus, as anticipated, perceived message arousal was similar for all message conditions.

Motor vehicle message arousal. For those individuals exposed to the mixed message cues, paired *t*-tests were conducted to compare the mean arousal ratings of the social loss-framed message to the mean arousal ratings of the motor vehicle message. As expected, there was no significant difference, suggesting that the social loss-framed message and motor vehicle message were equally arousing to these participants (see Table 7.7).

Individual word arousal ratings. A 3 (message condition: physical, social, vehicle) x 3 (word source: physical words, social words, vehicle words) mixed-groups ANOVA assessed the perceived arousal effects of the words included in the LDT. As anticipated, there were no significant differences in perceived arousal between the word sets used in the three message conditions, $F(4, 260) = 0.92$, $p = .454$. Thus, following the word substitutions changes made in Studies 1a and 1c (chapter 6, section 6.13), word arousal appeared to be similar for all message conditions, as intended.

Table 7.5

Message Arousal: Ratings as a Function of Message Frame

Variable	*n*	*M (SD)*	*F*	*p*	95% CI	η^2
Calm/ Jittery						
Loss-framed	54	3.13 (1.57)				
Gain-framed	54	2.80 (1.53)	1.25	.267	-0.93, 0.26	.01
Dull/ Excited						
Loss-framed	54	3.48 (1.08)				
Gain-framed	54	3.48 (1.15)	< 0.01	1.00	-0.42, 0.42	.00
Unaroused/ Aroused						
Loss-framed	54	3.41 (1.58)				
Gain-framed	54	3.30 (1.48)	0.14	.707	-0.47, 0.70	.00

Note. CI = Confidence Interval

Table 7.6

Message Arousal: Ratings as a Function of Message Type

Variable	*n*	*M (SD)*	*F*	*p*	95% CI	η^2
Calm/ Jittery						
Physical	54	3.24 (1.54)				
Social	74	2.99 (1.61)	0.83	.365	-0.29, 0.81	.01
Dull/ Excited						
Physical	54	3.39 (1.11)				
Social	74	3.63 (1.17)	1.46	.229	-0.64, 0.16	.01
Unaroused/ Aroused						
Physical	54	3.41 (1.57)				
Social	74	3.41 (1.47)	< 0.01	.993	-0.53, 0.53	.00

Note. CI = Confidence Interval

Table 7.7

Message Arousal: Ratings by Participants in the Mixed Cue Condition (Social Loss-framed Message vs. Motor Vehicle Message)

Variable	*n*	*M (SD)*	*t*	*p*	95% CI	η^2
Calm/ Jittery						
Social loss-framed	25	3.64 (1.60)				
Motor vehicle	25	3.40 (1.47)	0.61	.547	-0.57, 1.05	.01
Dull/ Excited						
Social loss-framed	25	3.76 (1.30)				
Motor vehicle	25	4.00 (1.83)	- 0.50	.620	- 1.23, 0.75	.02
Unaroused/ Aroused						
Social loss-framed	25	3.64 (1.44)				
Motor vehicle	25	3.80 (1.83)	- 0.38	.709	- 1.03, 0.71	.00

Note. CI = Confidence Interval

Individual word valence ratings. Similar to individual word arousal ratings, a 3 x 3 mixed-groups ANOVA assessed the influence of message condition and word source effects in perceived valence of the words included in the LDT. There were no significant differences in perceived valence between the word sets used in the three message conditions, $F(4, 256) = 0.68$, $p = .607$, as expected. Thus, the words were of similar valence across all three message conditions.

7.5.5 Reaction times to the message words

As discussed in chapter 5, the spreading activation theory of semantic processing proposes that semantic concepts are represented by nodes and that spreading activation occurs when a node activates a related node via their connected pathways (e.g., Collins & Loftus, 1975). Based on this theory, individuals should be faster to respond to words that have been recently primed (i.e., in this case, words that were included in the previously viewed message). More specifically, and in regards to the repetition priming effect, individuals should be quicker to respond to repeated words than words that have not been repeated. To examine this priming effect, a series of one-way between-groups ANOVAs were used to assess differences in participants' RTs to the words that they were exposed to in the previously viewed message compared to the words in the other message conditions, which they had not previously been exposed to prior to the LDT.

Physical condition. Inconsistent with expectations, individuals who viewed the physical messages showed slightly faster mean RTs to the social message words (M = 604.47ms, SD = 67.99) than to the physical message words (M = 619.97ms, SD = 65.35) in the LDT. However, in line with the predictions of the spreading activation theory of semantic processing, participants exposed to the physical message showed slightly faster RTs to the physical words than to the motor vehicle message words in the LDT (M = 641.78ms, SD = 64.80). There were, however, no significant differences between the mean RTs, $F(2, 132) = 0.05$, $p = .956$.[42]

Social condition. The direction of means indicated that participants who viewed the social messages showed slightly faster RTs to the social message words in the LDT (M = 593.16ms, SD = 67.99) than to the physical message words (M = 617.64ms, SD = 66.54) and motor vehicle message words (M = 629.74ms, SD = 63.76). The direction of means are consistent with the repetition priming effect. However, the one-way ANOVA revealed that these differences were not significant, $F(2, 132) = 0.41$, $p = .666$.

Motor vehicle condition. Participants who viewed the vehicle message showed virtually identical mean RTs to the motor vehicle message words included in the LDT (M = 624.98ms, SD = 47.90) compared to the physical message words (M = 622.14ms, SD = 55.77) and social message words (M = 601.56ms, SD = 63.68). However, similar to the physical and social conditions, the one-way ANOVA revealed that this difference was not significant, $F(2, 131) = 0.83$, $p = .440$.

[42] There were no significant differences in participants RTs to the corresponding filler words for each of the three message conditions (i.e., physical condition, social condition, or motor vehicle condition).

7.5.6 Baseline group differences

To assess if pre-existing age differences existed between the five experimental message conditions (i.e., physical gain-framed, physical loss-framed, social gain-framed, social loss-framed and the mixed social loss-framed/ motor vehicle message condition), a one-way between-groups ANOVA was conducted. The ANOVA results revealed that there were no significant differences on age between those that viewed the physical gain-framed message (M = 20.73, SD = 2.69), physical loss-framed message (M = 19.43, SD = 2.44), social gain-framed message (M = 19.76, SD = 2.45), social loss-framed message (M = 19.39, SD = 2.39), and vehicle message (M = 20.30, SD = 2.43), $F(4, 128) = 1.46$, $p = .218$. As such, the findings support that all groups included young drivers of similar ages.

A series of chi-square frequency tests were next conducted to examine potential group differences on four demographic variables: gender, licence type, driving fines, and speeding behaviour. The chi-square frequency tests indicated that the five experimental groups consisted of participants with similar licence types, $\chi^2(8) = 11.96$, $p = .153$, number of self-reported driving fines, $\chi^2(4) = 0.47$, $p = .977$, and self-reported speeding behaviour, $\chi^2(4) = 0.33$, $p = .988$. However, compared to the four message conditions where there were a greater proportion of females than males,[43] the mixed cue condition consisted of an equal number of females (n = 12) and males (n = 13), $\chi^2(4) = 14.49$, $p = .006$. Due to the significant gender proportion differences between the social loss-framed only message condition[44] and mixed cue condition, as well as the findings from the group discussions in Study 1c (i.e., males reported that they would be more persuaded by the social loss-framed message and motor vehicle message than females; see chapter 3, section 6.12.3), a series of independent groups *t*-

[43] Physical gain-framed message (females, n = 21; males, n = 6), Physical loss-framed message (females, n = 24; males, n = 3), Social gain-framed message (females, n = 18; males, n = 9), and Social loss-framed message (females, n = 23; males, n = 4).

[44] Only the social loss-frame message condition was compared to the mixed cue condition.

tests were conducted to further examine the potential effects of gender. The results revealed that male drivers (*M* = 4.96, *SD* = 1.42) were significantly less likely to comply with the social loss-framed message than female drivers (*M* = 5.76, *SD* = 0.82), $t(34) = -2.13$, $p = .041$, 95% CI [-1.57, -0.04], $\eta^2 = .14$. Gender was thus statistically controlled by entering it as a CV in all further analyses that examined participants' self-reported behaviour (i.e., message compliance) for the one week after viewing the social loss-framed message. No additional significant gender differences on message acceptance were found relating to either the social loss-framed message (see Table 7.8) and motor vehicle message (see Table 7.9).

Table 7.8

Gender Differences on Message Processing and Acceptance: Social Loss-framed Message Condition

Variable	*n*	*M (SD)*	*t*	*p*	95% CI	η^2
Social processing						
Male	17	598.78 (58.61)				
Female	35	594.44 (67.70)	0.24	.813	-32.66, 41.34	.00
Message effectiveness						
Male	17	4.85 (1.84)				
Female	35	5.83 (1.22)	-1.99^{+}	.059	-1.99, 0.04	.09
Message attitudes						
Male	17	5.78 (1.27)				
Female	35	6.27 (0.79)	-1.68	.098	-1.06, 0.09	.07
Message intentions						
Male	17	5.75 (1.04)				
Female	35	6.06 (0.75)	-1.23	.226	-0.82, 0.20	.05

Note. + Homogeneity of variance breached ($p < .05$) and therefore, equal variance not assumed statistic is reported; CI = Confidence Interval

Table 7.9

Gender Differences on Message Processing and Acceptance: Mixed Cue Condition (Social Loss-framed Message vs. Motor Vehicle Message)

Variable	*n*	*M (SD)*	*t*	*p*	95% CI	η^2
Vehicle message processing						
Male	13	626.49 (56.24)				
Female	12	623.34 (39.38)	0.16	.874	-37.35, 43.65	.00
Vehicle message effectiveness						
Male	13	3.65 (1.81)				
Female	12	3.63 (1.72)	0.04	.968	-1.43, 1.49	.00
Vehicle message attitudes						
Male	13	3.90 (1.79)				
Female	12	4.56 (1.12)	-1.09	.287	-1.91, 0.59	.09
Vehicle message goals						
Male	13	4.53 (1.61)				
Female	12	3.78 (1.55)	1.18	.251	-0.57, 2.06	.05

Note. CI = Confidence Interval

7.5.7 Baseline objective personality measure

CARROT scores. Participants, on average, sorted the first 60 cards in 66.90 seconds (*SD* = 16.44). Subsequent trials were individually time limited by participant's trial 1. The CARROT score (i.e., T3 – [T2+T4/2]) in the current sample was -0.09 (*SD* = 4.37), indicating that, on average, there were no differences in sorting speeds between the non-reward and reward trials. On average, participants earned $2.68 (*SD* = 0.52) in the reward trial (i.e., sorted an average 67 cards in the trial 3).

Q-Task scores. As with the LDT, a cut-off filter of 1000ms was applied in E-prime to remove scores with excessively long RTs prior to computing mean RTs from participants' correct responses to the first 15 Q-present trials and first 15 Q-absent trials (see Ratcliff, 1993 for a review on RT outliers). The mean percentage of correct responses for the Q-present trials was 97% and for the Q-absent trials, 99%, indicating that there was similar accuracy levels across the two conditions. On average, participants were quicker to respond to the Q-present (*M* = 629.42ms, *SD* = 78.25) than the Q-absent trials (*M* = 645.71ms, *SD* = 82.64), resulting in an average mean Q-score of, -16.29ms (*SD* = 40.25). As stated in section 7.4.3.2, slower responses in the Q-present trials (compared to the Q-absent trials) in phase 2 reflect greater avoidance/ inhibition to punishment cues, in this case, the letter Q that was presented in phase 1. However, on average, participants were quicker to respond to the Q-present than Q-absent trials thus, suggesting approach rather than avoidance/ inhibition behaviour to the punishment cue.

7.5.8 Preliminary findings

Personality scores. The mean values and standard deviations across the sample for all RST scale scores are presented in Table 7.10. As anticipated, there were significant moderate to strong positive correlations between most self-reported reward scales, between most self-reported punishment scales, and between the BIS self-report scales (see Tables 7.11 and 7.12).[45] However, no significant correlations were found between the CARROT and self-reported reward scales or between the Q-Task and self-reported punishment scales. The CARROT scores, however, showed significant moderate positive correlations with CC BIS scale (r = .280, p = .001), CW BIS scale (r = .246, p = .005), and CW BIS: Anxiety scale (r = .265, p = .002). That is, higher BIS trait scores were associated with faster card sorting under financial reward versus. non-reward trials. Based on these unexpected but consistent significant relationships between the CARROT and the self-report BIS scales, the CARROT was included in the main BIS analyses to explore if there were any significant effects of the

[45] Whilst CC Defensive Fight and CC Panic Scales were developed separately from the BAS and the FFFS traits (see Corr & Cooper, 2013), for the purpose of this research program, CC Defensive Fight was compared with the BAS traits and CC Panic was compared with the FFFS/ BIS traits.

CARROT (as a check for BIS sensitivity) on the processing and/ or acceptance in the mixed social loss-framed/ motor vehicle message condition (designed to activate the BIS).[46]

Table 7.10

Descriptive Statistics for the Personality Mean Scale Scores

Personality Subscales	*n*	*M (SD)*
Carver and White BIS/ BAS Scales		
BAS: Reward Responsiveness	132	3.45 (0.44)
BAS: Drive	132	2.64 (0.64)
BAS: Fun Seeking	132	2.93 (0.61)
BIS	132	3.04 (0.46)
BIS: Anxiety	132	3.15 (0.50)
BIS: Fear	132	2.89 (0.57)
Corr and Cooper's RST-PQ		
BAS: Reward Interest	132	2.79 (0.54)
BAS: Goal-Drive Persistence	132	3.15 (0.51)
BAS: Reward Reactivity	132	2.98 (0.48)
BAS: Impulsivity	132	2.54 (0.53)
Defensive Fight	132	2.56 (0.49)
FFFS	133	2.18 (0.57)
BIS	132	2.61 (0.57)
Panic	132	2.32 (0.68)
Jackson-5 Scales		
BAS	133	3.82 (0.51)
BIS	133	3.71 (0.57)
FFFS	133	2.82 (0.38)
Flight	133	2.84 (0.48)
Fight	133	2.65 (0.69)
Freezing	133	3.16 (0.70)

[46] While it was concluded that the CARROT and Q-Task were not suitable measures of reward and avoidance/ inhibition behaviour, respectively, for any readers interested in the main CARROT and Q-Task correlation, mediation, and ANOVA findings please refer to Appendix C.

Table 7.11

Bivariate Correlations between Self-report and Objective BAS Trait Measures

	1	2	3	4	5	6	7	8	9	10
1. CW BAS: Reward Responsiveness	-									
2. CW BAS: Drive	.520**	-								
3. CW BAS: Fun Seeking	.176*	.192*	-							
4. CC BAS: Reward Interest	.284**	.454**	.458**	-						
5. CC BAS: Goal-Drive Persistence	.263**	.376**	.056	.492**	-					
6. CC BAS: Reward Reactivity	.658**	.407**	.249**	.460**	.340**	-				
7. CC BAS: Impulsivity	.098	.174*	.556**	.361**	-.026	.265**	-			
8. CC Defensive Fight	.240**	.139	.251**	.324**	.161	.364**	.176*	-		
9. J5 BAS	.143	.298**	.587**	.590**	.171*	.244**	.485**	.217*	-	
10. CARROT	-.024	-.091	.000	-.160	-.141	.061	.038	.048	-.086	-

Note. CW = Carver and White BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales; Objective behavioural measure = CARROT
** $p < .001$
* $p < .05$

Table 7.12

Bivariate Correlations between Self-report and Objective BIS and FFFS Traits Measures

	1	2	3	4	5	6	7	8	9	10	11	12
1. CW BIS	-											
2. CW BIS: Anxiety	.891**	-										
3. CW FFFS: Fear	.847**	.512**	-									
4. CC BIS	.691**	.616**	.584**	-								
5. CC FFFS	.399**	.272**	.436**	.385**	-							
6. CC Panic	.612**	.504**	.565**	.736**	.491**	-						
7. J5 BIS	.240**	.273**	.131	.218*	.221*	.232**	-					
8. J5 Fight	-.176*	-.188*	-.118	-.140	-.148	-.191*	.192*	-				
9. J5 Flight	.424**	.439**	.287**	.545**	.315**	.545**	.334**	.049	-			
10. J5 Freezing	.449**	.342**	.449**	.539**	.535**	.539**	.069	.296**	.233**	-		
11. J5 FFFS	.382**	.280**	.394**	.373**	.573**	.409**	.280**	.303**	.357**	.673**	-	
12. Q-Task	-.058	-.076	-.025	-.116	-.014	-.027	.046	.086	-.010	-.138	-.075	-

Note. CW = Carver and White BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales; Objective behavioural measure = Q-Task. Please note all 4 CW BIS: Anxiety items and all 3 CW FFFS: Fear items are part of the 7 item CW BIS scale.
** $p < .001$ * $p < .05$

While the majority of self-reported punishment scales showed significant strong to moderate positive inter correlations, one exception was Jackson's Fight Scale, which in contrast, was moderately to weakly negatively correlated with all punishment and behavioural inhibition scales.[47] However, Jackson's Fight scale was shown to have significant weak to strong positive relationships with three reward/ approach scales: CC Defensive Fight (r = .681, p < .001), CC BAS: Reward Interest (r = .228, p = .008), and CW BAS: Drive (r = .179, p = .041). These findings may indicate that Jackson's Fight scale could reflect more reward/ approach behaviours than punishment/ avoidance behaviours.

Message acceptance measures. As expected, there were significant moderate to strong positive correlations between the four road safety message acceptance scales (i.e., message effectiveness, behavioural intentions, attitudes, and message compliance; see Table 7.13). Further, there was a significant strong positive correlation between the three measures of vehicle message acceptance (i.e., motor vehicle effectiveness, attitudes, and goals; see Table 7.13), as anticipated. These findings support the suitability of these self-report scales as measures of the road safety message and motor vehicle acceptance, respectively. It is also worth noting that for those individuals exposed to the mixed message condition, there was a significant moderate negative correlation between behavioural intentions towards the road safety message and motor vehicle message attitudes, indicating that individuals who were more likely to report intentions to comply with the social loss-framed message were less likely to show favourable attitudes towards the vehicle message (and vice versa). The mean values and standard deviations for all message acceptance scale scores are also presented in Table 7.13.

[47] There was, however, a positive relationship between Jackson's Fight and FFFS scales. This relationship would be expected as the six Fight items make up one-third of the total FFFS scale.

Table 7.13

Descriptive Statistics and Bivariate Correlations between Road Safety Message and Motor Vehicle Message Acceptance Measures

	n	*M (SD)*	1	2	3	4	5	6
1. RS message effectiveness	133	5.29 (1.52)	-					
2. RS message attitudes	133	6.09 (0.97)	.550**	-				
3. RS Behavioural intentions	133	5.81 (0.93)	.648**	.755**	-			
4. RS message compliance^{+}	88	5.27 (1.02)	.551**	.566**	.639**	-		
5. MV message effectiveness	25	5.28 (1.73)	.328	-.073	-.169	-.211	-	
6. MV message attitudes	25	4.21 (0.97)	.232	-.358	-.495*	-.365	.762**	-
7. MV message goals	25	4.17 (1.60)	-.024	-.272	-.337	-.211	.749**	.634**

Note. RS = road safety. MV = motor vehicle. Motor vehicle effectiveness, attitudes, and goals, only includes responses from those who viewed both the motor vehicle and road safety message; road safety message acceptance responses are from all participants

$^{+}$ Message compliance was measured at time 2 (one week after message exposure), while all remaining measures were assessed after viewing the message at time 1.

** $p < .001$

* $p < .05$

To further assess if the road safety messages were functioning as intended, a series of independent groups *t*-tests were conducted to examine the differences between participants' intentions to comply with the message (assessed at time 1) and self-reported message compliance (assessed at time 2). Participants were significantly more likely to report greater intentions to comply with the messages than actual message compliance (see Table 7.14). Despite these findings, all message compliance means were above 4 (measured on a 7-point Likert Scale, 1 = *strongly disagree* and 7 = *strongly agree*) suggesting that participants complied with the road safety messages.

Table 7.14

Behavioural Intentions and Message Compliance Ratings for Each Message Condition

Variable	*M (SD)*	*t*	*p*	95% CI	η^2
Physical gain-framed message condition (*n* = 16)					
Behavioural intentions	5.66 (0.75)				
Message compliance	5.09 (1.07)	3.75	.002	0.25, 0.90	.50
Physical loss-framed message condition (*n* = 18)					
Behavioural intentions	5.66 (0.91)				
Message compliance	4.98 (0.74)	3.58	.002	0.28, 1.08	.44
Social gain-framed message condition (*n* = 18)					
Behavioural intentions	6.03 (0.99)				
Message compliance	5.24 (1.04)	4.03	.001	0.38, 1.20	.50
Social loss-framed message condition (*n* = 17)					
Behavioural intentions	6.11 (0.66)				
Message compliance	5.53 (0.90)	2.50	.024	0.09, 1.07	.29
Mixed condition: Social loss-framed message (*n* = 19)					
Behavioural intentions	5.97 (0.99)				
Message compliance	5.51 (1.25)	2.31	.033	0.04, 0.88	.24

7.5.9 Main findings

To test the main hypotheses, correlations and mediations were first undertaken separately for the BAS personality traits within gain-framed conditions, the FFFS personality traits within loss-framed conditions, and for the BIS personality traits within the mixed message condition (social loss-framed message and motor vehicle message). Next, between-groups ANOVAs were conducted to examine the individual effects of the RST traits on message processing and message acceptance, as a function of message frame (i.e., loss-framed vs. gain-framed) or mixed message cues (i.e., social loss-framed only condition vs. social loss-framed and motor vehicle message combined condition). The BAS/ gain-framed and FFFS/ loss-framed message analyses are first presented, followed by the analyses that examined the BIS within the mixed message condition. The findings from Corr and Cooper's RST-PQ and Jackson-5 Scales are presented below, whilst the findings from Carver and White's BIS/ BAS Scales are presented in Appendix D.[48]

7.5.10 H.1: BAS trait and gain-framed message effects

Physical gain-framed message.

Bivariate correlations. For the physical gain-framed message, and inconsistent with expectations, there were zero to weak correlations between the BAS scales and message processing (RT to LDT message words), all of which were not significant. However, for CC BAS: Goal-Drive Persistence and CC BAS: Impulsivity scales, there were significant moderate positive relationships with attitudes and message effectiveness, respectively (see Table 7.15). Higher scores on these scales were associated with more favourable attitudes towards the physical gain-framed message and higher ratings of message effectiveness, respectively.

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[48] , Given that Carver and White's BIS/ BAS Scales were developed to assess Gray's original RST, the focus of this section is on Corr and Cooper's RST-PQ and Jackson-5 Scales, both of which were developed to assess Gray and McNaughton's revised RST traits.

Table 7.15

Bivariate Correlations between BAS Traits and Message Processing and BAS Traits and Message Acceptance for Participants who viewed the Physical Gain-framed Message

	Processing (RT)	Message effectiveness	Attitudes	Behavioural intentions	Message compliance
BAS Subscales					
CC BAS: Reward Interest	-.105	.210	.323	.145	.029
CC BAS: Goal-Drive Persistence	-.125	.063	.401*	.295	-.055
CC BAS: Reward Reactivity	-.166	-.073	.146	.094	-.230
CC BAS: Impulsivity	.020	.388*	.357	.150	.413
CC Defensive Fight	.028	.045	.267	-.073	-.012
J5 BAS	.028	.082	.215	.084	.322

Note. CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales
* $p < .05$

Further, there were moderate positive correlations between CC BAS: Reward Interest and attitudes and between CC BAS: Impulsivity and attitudes which both approached significance in the predicted directions (p = .100 and p = .067, respectively). Similarly, although failing to reach significance, there was a moderate positive correlation in the expected direction between CC BAS: Impulsivity and message compliance, p = .112.

Mediation analyses. There were no significant mediations between the BAS traits, processing of the words in the physical gain-framed message, and message acceptance ratings (see Appendix E).

Social gain-framed message.

Bivariate correlations. There were weak correlations between the BAS personality traits and processing of the words in the social gain-framed message, which all failed to reach significance. There were, however, significant moderate positive correlations between CC BAS: Goal-Drive Persistence and attitudes and between CC BAS: Goal-Drive Persistence and intentions, indicating that those higher on this trait were more likely to show favourable attitudes towards the message, and report greater intentions to comply with the social message (see Table 7.16). While not significant, the relationships between CC BAS: Goal-Drive Persistence and message effectiveness and between CC BAS: Goal-Drive Persistence and message compliance approached significance in the predicted direction (i.e., moderate positive correlation; p = .060 and p = .064, respectively; see Table 7.16).

Mediation analyses. There were no significant mediation effects between the BAS personality traits, processing of the words in the social gain-framed message, and message acceptance ratings (see Appendix F). These findings were inconsistent with H.1, which predicted that individuals with a stronger BAS would demonstrate a greater cognitive bias towards the content presented via the gain-framed messages and subsequently, be more likely to accept these messages than those with a weaker BAS.

Table 7.16

Bivariate Correlations between BAS Traits and Message Processing and between BAS Traits and Message Acceptance for Participants who viewed the Social Gain-framed Message

	Processing (RT)	Message effectiveness	Attitudes	Behavioural intentions	Message compliance
BAS Subscales					
CC BAS: Reward Interest	-.088	.037	.221	.186	.121
CC BAS: Goal-Drive Persistence	-.049	.366	.482*	.488**	.445
CC BAS: Reward Reactivity	-.197	.170	.244	.264	.161
CC BAS: Impulsivity	-.062	-.042	-.036	-.042	-.195
CC Defensive Fight	-.022	-.015	.291	.151	.091
J5 BAS	-.200	.127	.035	-.044	-.201

Note. CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales
** $p < .001$
* $p < .05$

7.5.11 H.2: FFFS traits and loss-framed message effects

Physical loss-framed message.

Bivariate correlations. The results indicated a moderate positive relationship between Jackson's Fight scores and RT to the words presented in the physical message, which approached significance, $p = .075$ (see Table 7.17). However, the direction of this relationship was contrary to expectations as the positive direction indicated less processing (slower RT) of the physical loss message by those with higher Fight scores. There were weak correlations between the remaining FFFS traits and processing of the words in the physical message, all of which failed to reach significance (see Table 7.17). With the exception of Jackson's Fight, the findings also revealed weak to moderate positive relationships between Jackson's FFFS scales and attitudes and behavioural intentions. Specifically, individuals with stronger Flight and Freezing traits perceived the physical loss-framed message to be more favourable, as supported by significant moderate positive correlations. A similar relationship was also found for Jackson's total FFFS, however, it could be argued that this finding reflects independent Flight and Freezing subsystems.[49] Finally, there was a significant positive relationship between the Jackson's Freezing trait and behavioural intentions, indicating that stronger Freezing tendency was associated with greater reported intended compliance with the physical loss-framed message. While not significant, there were moderate positive correlations between CC FFFS and attitudes and between J5 Freezing and message compliance which both approached significance in the expected directions ($p = .105$ and $p = .152$, respectively; see Table 7.17).

[49] Jackson's Flight and Freezing scales make-up two thirds of Jackson's total FFFS scale.

Table 7.17

Bivariate Correlations between FFFS Traits and Message Processing and between FFFS Traits and Message Acceptance for Participants who viewed the Physical Loss-framed Message

	Processing (RT)	Message effectiveness	Attitudes	Behavioural intentions	Message compliance
FFFS Subscales					
CC FFFS	-.234	.127	.319	.243	.258
CC Panic	.097	.193	.233	.252	.017
J5 FFFS	-.003	.184	.433*	.190	.547*
J5 Fight	.348	-.034	-.138	-.169	.083
J5 Flight	-.149	.232	.463*	.264	.176
J5 Freezing	-.160	.247	.482*	.395*	.352

Note. CC = Corr and Cooper’s RST-PQ; J5 = Jackson-5 Scales
* $p < .05$

Mediation analyses. There were no significant mediations between the FFFS personality traits, processing of the words in the physical loss-framed message, and message acceptance ratings (see Appendix G).

Social loss-framed message.

Bivariate correlations and Mediation analyses. All correlations between the FFFS traits, processing, and message acceptance were weak and failed to reach significance, with the exception of a moderate negative correlation between CC Panic and message compliance, although this relationship was also not significant, p = .118 (see Table 7.18). There were no significant mediations between the FFFS trait, processing of the social loss-framed message, and message acceptance measures (see Appendix H). These findings were inconsistent with t H.2, which predicted that individuals with a stronger FFFS (compared to those with a weaker FFFS) would demonstrate a greater cognitive bias towards the content presented via the loss-framed messages and subsequently, be more likely to accept these messages.

7.5.12 H.3: Message framing effects

Physical condition. A series of between-groups ANOVAs were undertaken to examine the potential effects of the individual RST traits on message processing and message acceptance, as a function of message frame (loss-framed vs. gain-framed messages), separately for each type of message (physical and social). For the physical messages, the results revealed some significant main effects and interactions of RST traits and message condition for message acceptance. However, despite these significant effects on message acceptance, there were no significant main effects of RST for message processing (see Appendix I for the non-significant findings). The significant RST main effects and interactions were interpreted using simple linear regressions and are presented below, with the corresponding statistics presented in Table 7.19.

Table 7.18

Bivariate Correlations between FFFS Traits and Message Processing and between FFFS Traits and Message Acceptance for Participants who viewed the Social Loss-framed Message

	Processing (RT)	Message effectiveness	Attitudes	Behavioural intentions	Message compliance
FFFS Subscales					
CC FFFS	-.038	-.030	.086	.137	.303
CC Panic	.106	-.062	-.001	-.005	-.394
J5 FFFS	-.270	-.007	.151	.143	.010
J5 Fight	-.073	-.298	-.250	-.136	-.093
J5 Flight	-.145	.076	.024	.044	-.276
J5 Freezing	-.196	.031	.190	.040	.068

Note. CC = Corr and Cooper’s RST-PQ; J5 = Jackson-5 Scales
* $p < .05$

Table 7.19

Significant ANOVA Effects of BAS/ FFFS Traits and Framing (Gain vs. Loss) on Message Acceptance for the Physical Message Conditions

Effect	*F*	*p*	η^2
CC BAS: Impulsivity and framing on message effectiveness (*n* = 54)			
Impulsivity	1.31	.258	.02
framing	4.82	.033	.08
Impulsivity x framing	4.68	.035	.08
CC BAS: Impulsivity and framing on attitudes (*n* = 54)			
Impulsivity	0.54	.466	.01
framing	4.67	.035	.08
Impulsivity x framing	5.12	.028	.09
Jackson’s FFFS and framing on attitudes (*n* = 54)			
FFFS	4.78	.033	.09
framing	1.78	.188	.03
FFFS x framing	1.78	.188	.03
Jackson’s Flight and framing on attitudes (*n* = 54)			
Flight	8.82	.005	.15
framing	1.40	.243	.02
Flight x framing	1.22	.275	.02
Jackson’s Freezing and framing on attitudes (*n* = 54)			
Freezing	6.67	.013	.12
framing	2.49	.121	.04
Freezing x framing	2.42	.126	.04
Jackson’s Freezing and framing on behavioural intentions (*n* = 54)			
Freezing	5.40	.024	.10
framing	1.21	.277	.02
Freezing x framing	1.42	.240	.03
Jackson’s FFFS and framing on message compliance (*n* = 34)			
FFFS	4.21	.049	.12
framing	1.48	.233	.04
FFFS x framing	1.12	.237	.04

Note. CC = Corr and Cooper’s RST-PQ

CC BAS: Impulsivity and framing on message effectiveness. There was a significant main effect of framing on message effectiveness and a significant interaction between BAS: Impulsivity and framing. As predicted, the linear regression revealed that there was a significant partial positive correlation between BAS: Impulsivity and message effectiveness for the physical gain-framed message, $r = .389$,[50] $p = .045$, accounting for 15.1% of the variance; but not for the loss-framed message, $r = .161$, $p = .425$. As shown below in the simple slopes graph, individuals with higher BAS: Impulsivity ratings were more likely to perceive the physical gain-framed message to be effective (see Figure 7.3).

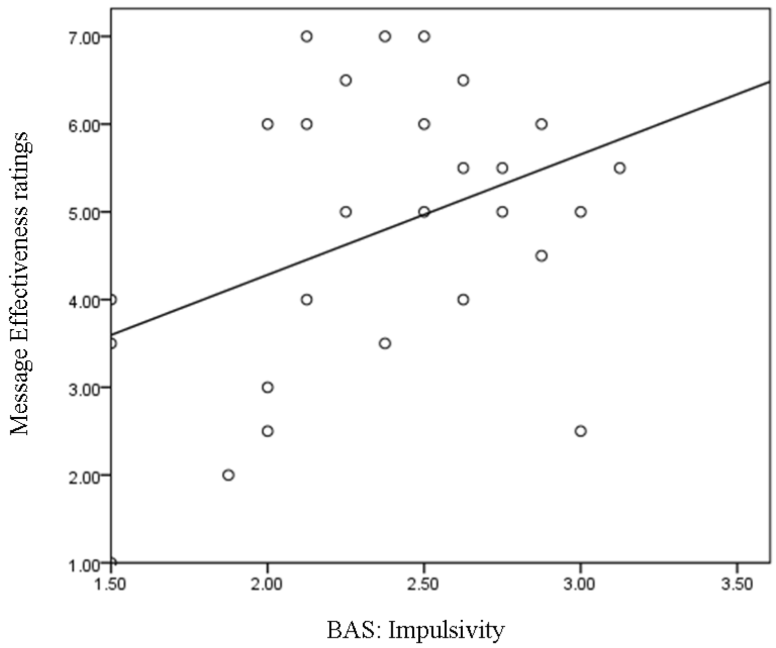

Figure 7.3. Partial correlation of CC BAS: Impulsivity and message effectiveness ratings for the physical gain-framed message.

[50] All effect size statistics presented for the liner regressions have been converted to *r*.

CC BAS: Impulsivity and framing on attitudes. There was a significant main effect of framing on attitudes and a significant BAS: Impulsivity x framing interaction. The partial correlation approached significance between BAS: Impulsivity and attitudes for the physical gain-framed message, $r = .358$, $p = .067$, accounting for 12.8% of the variance. The slope of the regression line indicated that the results, although not significant, were in the predicted direction (i.e., higher attitude ratings towards the physical gain-framed message for individuals with higher impulsivity ratings; see Figure 7.4). As with the effectiveness ratings and as anticipated, there was no significant partial correlation between BAS: Impulsivity and attitudes for the physical loss-framed message, $r = .237$, $p = .237$.

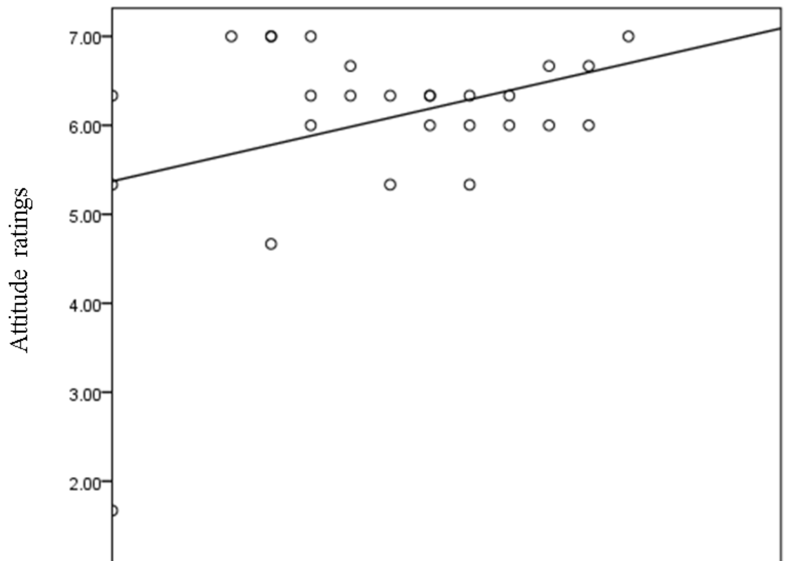

Figure 7.4. Partial correlation of CC BAS: Impulsivity and attitude ratings for the physical gain-framed message.

Jackson's FFFS, Flight, Freezing, and framing on attitudes. There was a significant main effect for each of Jackson's FFFS, Flight, and Freezing scales on attitudes. As shown in the simple slopes graphs (see Figures 7.5, 7.6, and 7.7, respectively), higher scores on Jackson's FFFS, Flight, and Freezing were associated with higher attitude ratings for the physical messages, regardless of message frame. There were no significant effects of framing nor were there significant FFFS trait x framing interactions.

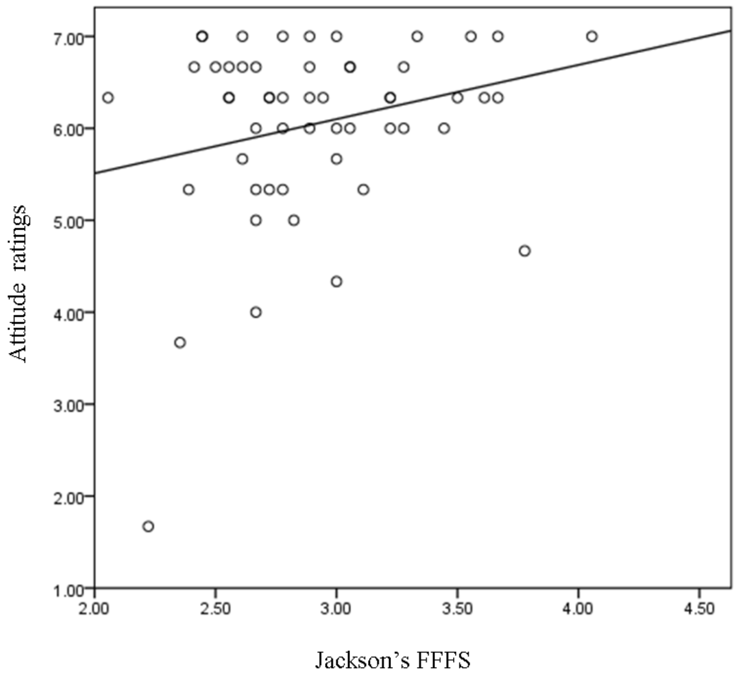

Figure 7.5. Partial correlation of Jackson's FFFS and attitude ratings for the physical messages.

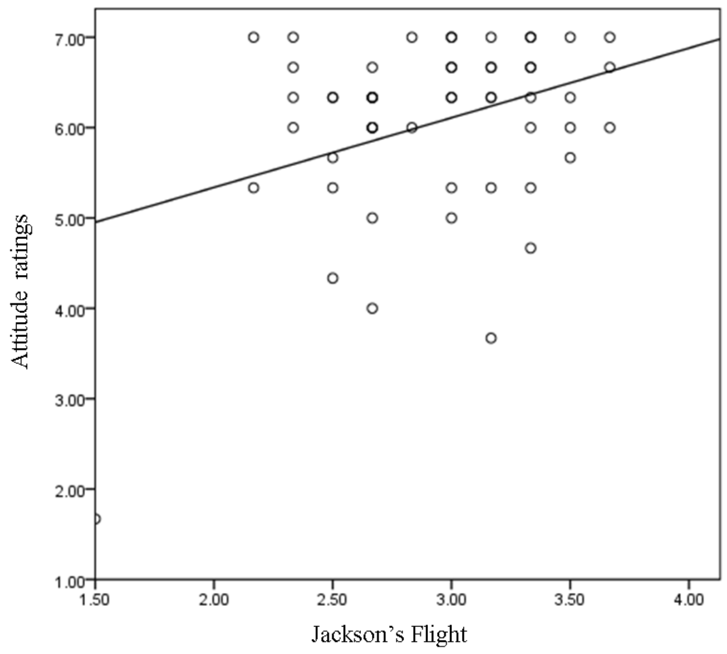

Figure 7.6. Partial correlation of Jackson's Flight and attitude ratings for the physical messages.

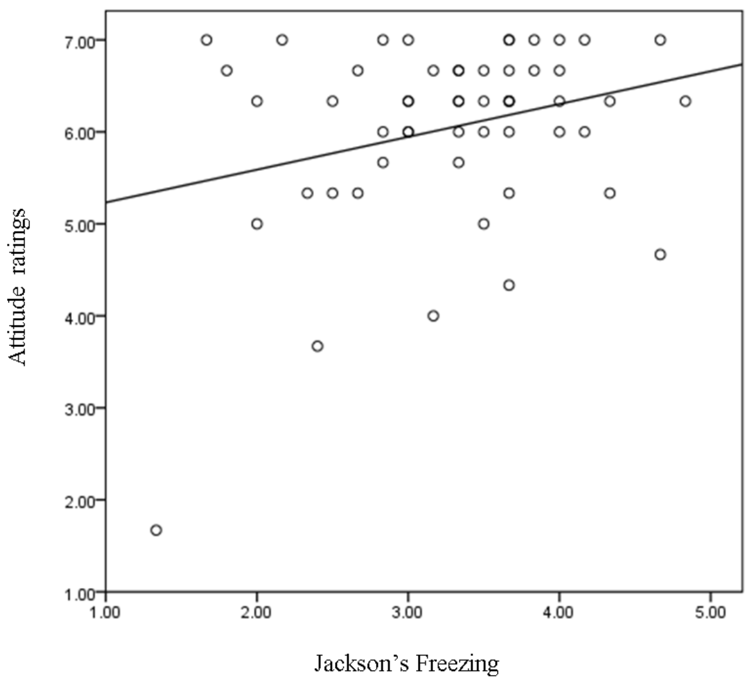

Figure 7.7. Partial correlation of Jackson's Freezing and attitude ratings for the physical messages.

Jackson's Freezing and framing on behavioural intentions. There was a significant main effect of Freezing, with the simple slopes graph (see Figure 7.8) showing that higher Freezing scores were associated with greater intentions to comply with the physical messages, again irrespective of framing. There were no significant main effects of framing or significant Freezing x framing interaction.

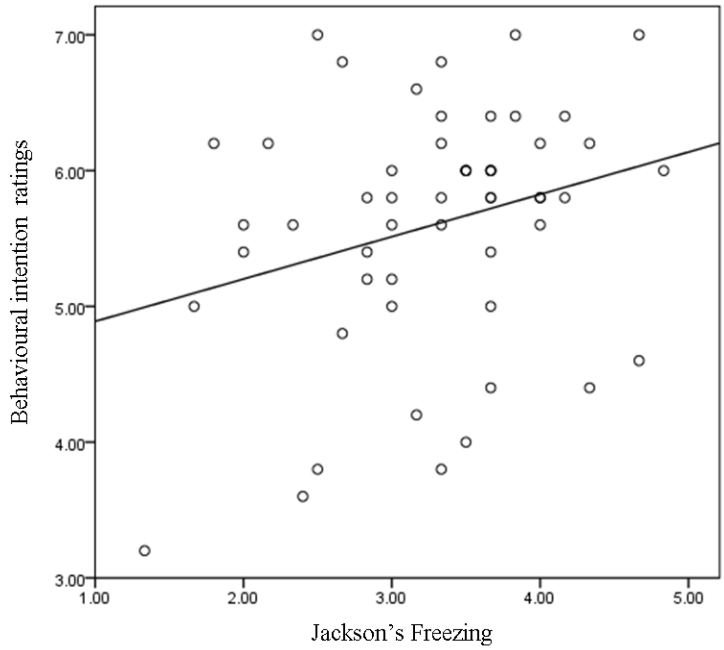

Figure 7.8. Partial correlation of Jackson's Freezing and behavioural intention ratings for the physical messages.

Jackson's FFFS and framing on message compliance. There was a significant main effect of FFFS, with the simple slopes graph revealing that higher FFFS scores were associated with higher self-reported behaviour of complying with the physical messages (see Figure 7.9), regardless of message frame. There were no significant main effects of framing or FFFS x framing interaction.

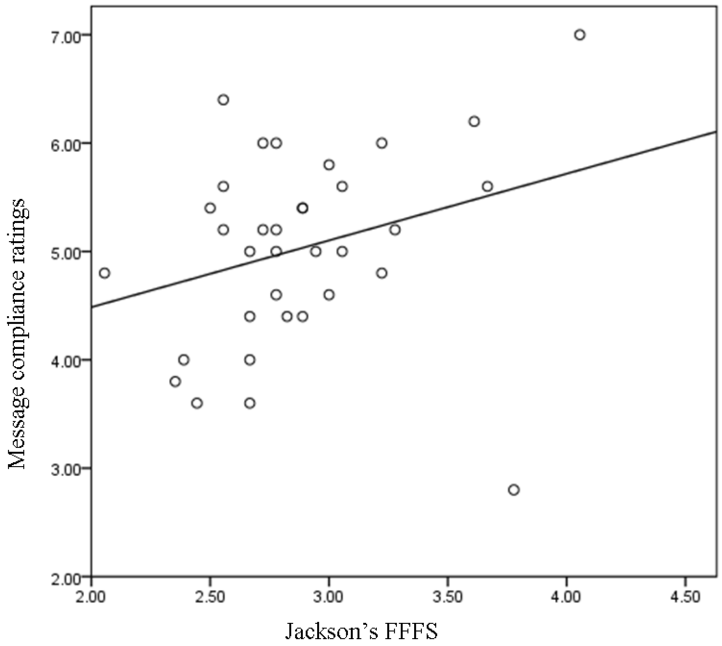

Figure 7.9. Partial correlation of Jackson's FFFS and message compliance ratings for the physical messages.

For the physical condition, the ANOVA findings also revealed that additional main effects of RST (i.e., CC BAS: Goal-Drive Persistence, and Jackson’s Freeze) approached significance, with medium effect sizes. Further, there were several RST x framing interactions that approached significance (i.e., CC BAS: Reward Interest x framing on attitudes, CC BAS: Impulsivity x framing on message compliance, and Jackson’s BAS x framing on attitudes and behavioural intentions), with medium effect sizes observed (see Table 7.20). While it is acknowledged that these interaction findings were not significant, the simple slope graphs indicated that the direction of the trend relationships between these RST traits and message condition were in the predicted direction (i.e., higher BAS scores tended to accompany higher ratings of processing and/ or message acceptance for the physical gain-framed message).

Overall, these interaction findings involving BAS traits provide partial support for H.3, which predicted that stronger BAS would predict greater acceptance of the physical gain-framed message compared to the physical loss-framed message. However, inconsistent with H.3, stronger BAS did not predict greater processing of the physical gain-framed message compared to the physical loss-framed message. Further, stronger FFFS did not predict greater processing and acceptance of the physical loss-framed message compared to the physical gain-framed message.

Table 7.20

ANOVA Trend Effects (p < .10) of BAS/ FFFS Traits and Framing (Gain vs. Loss) on Message Processing (RT) and Message Acceptance for the Physical Message Conditions

Effect	*F*	*p*	η_p^2
CC BAS: Reward Interest and framing on attitudes (*n* = 54)			
Reward Interest	1.03	.316	.02
framing	2.62	.112	.05
Reward Interest x framing	2.95	.092	.06
CC BAS: Goal-Drive Persistence and framing on attitudes (*n* = 54)			
Goal-Drive Persistence	3.80	.057	.07
framing	0.75	.390	.01
Goal-Drive Persistence x framing	0.78	.380	.01
CC BAS: Goal-Drive Persistence and framing on behavioural intentions (*n* = 54)			
Goal-Drive Persistence	3.20	.080	.06
framing	0.06	.812	.00
Goal-Drive Persistence x framing	0.03	.866	.00
CC BAS: Impulsivity and framing on message compliance (*n* = 34)			
Impulsivity	1.22	.277	.04
framing	3.22	.083	.09
Impulsivity x framing	3.75	.062	.11
Jackson's BAS and framing on attitudes (*n* = 54)			
BAS	0.17	.680	.00
Framing	3.63	.063	.07
BAS x framing	3.79	.057	.07
Jackson's BAS and framing on behavioural intentions (*n* = 54)			
BAS	1.40	.243	.03
framing	3.34	.073	.07
BAS x framing	3.08	.086	.06
Jackson's Freezing and Framing on message effectiveness (*n* = 54)			
Freezing	3.33	.074	.06
framing	0.01	.927	.00
Freezing x framing	0.04	.842	.00

Note. CC = Corr and Cooper's RST-PQ

Social condition. For the social messages, the ANOVAs revealed that only Jackson's FFFS and CC BAS: Goal-Drive Persistence showed significant main effects and/ or interactions on message processing or message acceptance. These significant findings are discussed below, with the non-significant results presented in Appendix J.

Jackson's FFFS and framing on processing. While there was a significant main effect of framing on processing of words included in the social messages, $F(1, 50) = 5.16$, $p = .027$, $\eta^2 = .09$, there was no significant main effect of FFFS, $F(1, 50) = 0.18$, $p = .671$, $\eta^2 = .00$. There was, however, a significant FFFS x framing interaction on processing, $F(1, 50) = 5.41$, $p = .024$, $\eta^2 = .10$. The linear regression revealed that the partial correlation approached significance between FFFS and processing of words in the social gain-framed message, $r = .351$, $p = .073$, accounting for 12.3% of the variance. There was no significant partial correlation between FFFS and processing words in the social loss-framed message, $r = .270$, $p = .174$. Despite these non-significant effects, the simple slopes were in the predicted direction (i.e., individuals with a stronger FFFS demonstrated slower RTs to words in the social gain-framed message and faster RTs to words in the social loss-framed message; see Figures 7.10 and 7.11).

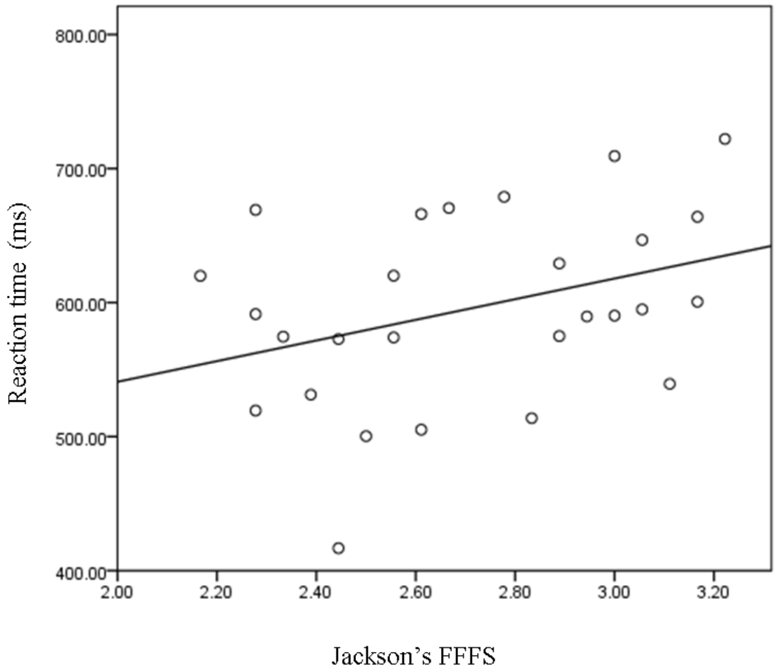

Figure 7.10. Partial correlation of Jackson's FFFS and RT for the social gain-framed message.

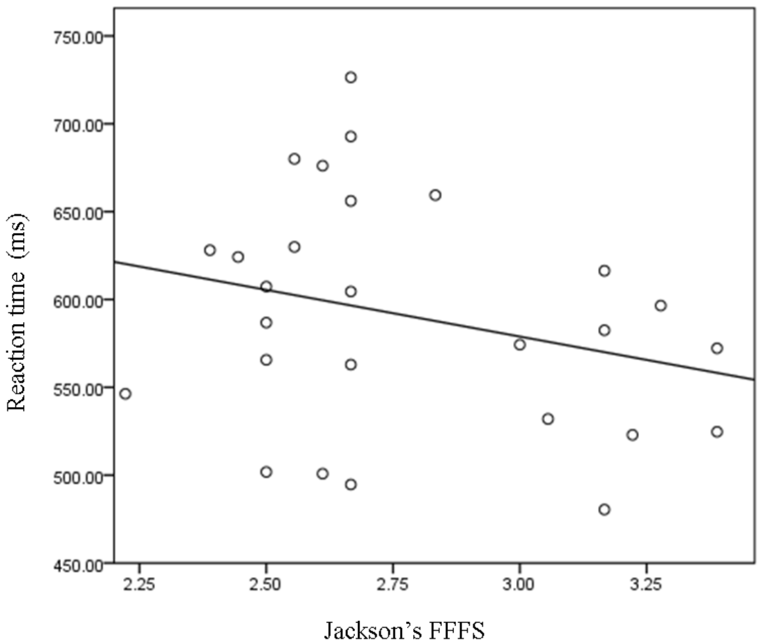

Figure 7.11. Partial correlation of Jackson's FFFS and RT for the social loss-framed message.

CC BAS: Goal-Drive Persistence and framing on attitudes. There was a significant main effect of framing on attitudes, $F(1, 50) = 4.58$, $p = .037$, $\eta^2 = .08$, but no significant main effect of BAS: Goal-Drive Persistence, $F(1, 50) = 2.66$, $p = .109$, $\eta^2 = .05$. There was a significant BAS: Goal-Drive Persistence x framing interaction on attitudes, $F(1, 50) = 4.76$, $p = .034$, $\eta^2 = .08$. The linear regression revealed that, in accordance with H.3, there was a significant partial positive correlation between BAS: Goal-Drive Persistence and attitudes ratings towards the social gain-framed message, $r = .483$, $p = .011$, accounting for 23.3% of the variance. The simple slopes graph (see Figure 7.12) shows that individuals with higher BAS: Goal-Drive Persistence scores reported more favourable attitudes towards the social gain-framed message. There was no significant partial correlation between BAS: Goal-Drive Persistence and attitudes towards the social loss-framed message, $r = .077$, $p = .701$, as expected.

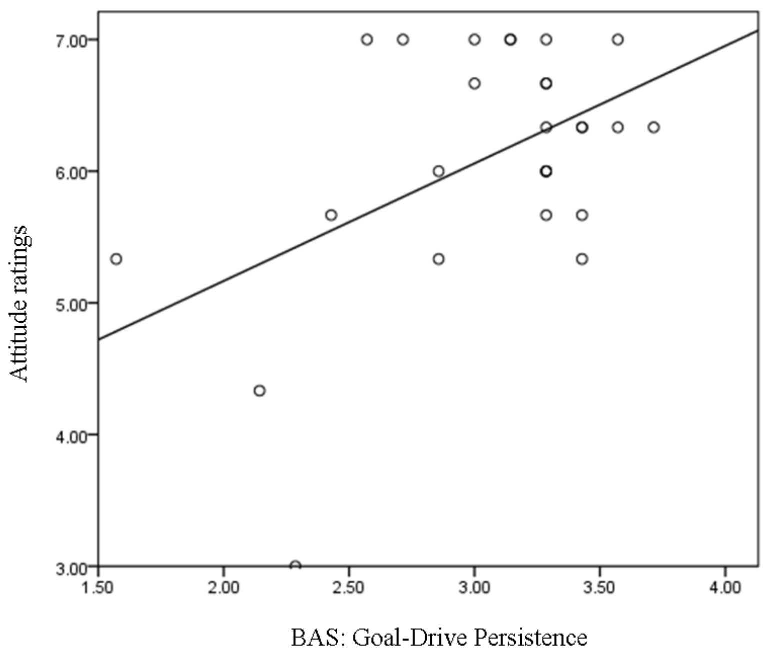

Figure 7.12. Partial correlation of CC BAS: Goal-Drive Persistence and attitude ratings for the social gain-framed message.

CC BAS: Goal-Drive Persistence and framing on behavioural intentions. There was a significant main effect of BAS: Goal-Drive Persistence, $F(1, 50) = 9.53$, $p = .003$, $\eta^2 = .16$, indicating that higher Goal-Drive Persistence ratings were associated with higher ratings of behavioural intentions to social messages, irrespectively of framing (see Figure 7.13). There was no significant main effect of framing, $F(1, 50) = 2.64$, $p = .110$, $\eta^2 = .04$, or BAS: Goal-Drive Persistence x framing interaction, $F(1, 50) = 1.73$, $p = .127$, $\eta^2 = .04$.

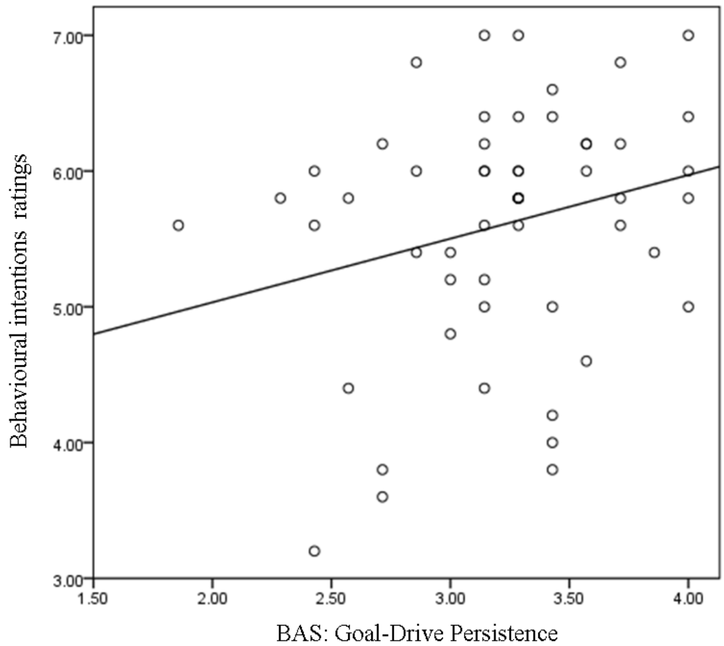

Figure 7.13. Partial correlation of CC BAS: Goal-Drive Persistence and behavioural intention ratings for the social messages.

For the social condition, the ANOVA findings also revealed that the main effects of CC BAS: Goal-Drive Persistence and Jackson's Fight approached significance, with medium effect sizes (see Table 7.21). Further, for CC Panic trait the interaction between Panic and framing on message compliance was approaching significance, with a medium effect size.[51] While not significant, the simple slopes graphs revealed that higher panic scores were associated with higher behaviour ratings for the social gain-framed message but, lower behaviour ratings for the social loss-framed message.

Overall, these findings provide some support for H.3, which predicted that individuals with a stronger BAS would show greater acceptance of the social gain-framed message than the social loss-framed message. However, inconsistent with H.3, stronger BAS did not predict greater processing of the social gain-framed message compared to the social loss-framed message. Further, stronger FFFS did not predict greater processing and acceptance of the social loss-framed message compared to the social gain-framed message.

[51] CC Panic trait was developed separately from the BAS and FFFS traits.

Table 7.21

ANOVA Trend Effects (p < .10) of BAS/ FFFS Traits and Framing (Gain vs. Loss) on Message Processing (RT) and Message Acceptance for the Social Message Conditions

Effect	*F*	*p*	η^2
CC BAS: Reward Reactivity and framing on processing (*n* = 54)			
Reward Reactivity	3.20	.080	.06
Framing	0.12	.729	.00
Reward Reactivity x framing	0.13	.724	.00
CC BAS: Goal-Drive Persistence and framing on message compliance (*n* = 35)			
Goal-Drive Persistence	3.31	.079	.09
Framing	1.69	.203	.05
Goal-Drive Persistence x framing	1.20	.282	.03
CC Panic and framing on message compliance (*n* = 35)			
Panic	0.16	.694	.00
Framing	3.37	.065	.11
Panic x framing	2.94	.096	.08
Jackson's Fight and framing on message effectiveness (*n* = 54)			
Fight	3.88	.055	.07
Framing	< 0.01	.964	.00
Fight x framing	< 0.01	.973	.00

Note. CC = Corr and Cooper's RST-PQ

7.5.13 H.4a: BIS and processing of information in the mixed message condition

Social loss-framed road safety message and motor vehicle message.

Bivariate correlations. For individuals exposed to both the social loss-framed and motor vehicle message, as predicted, there was a significant positive relationship, moderate to strong in size, between CC BIS scores and processing of the words from the social loss-framed message (see Table 7.22). That is, individuals with a stronger CC BIS showed inhibition/ avoidance (i.e., as indicated by slower RTs) to the words in the social loss-framed message when that message had been presented concurrently with the vehicle message. Further, there was a moderate positive relationship between CC Panic Scale and processing of the social words, which failed to reach significance, $p = .064$. While the relationship between CC BIS and processing of the words in the motor vehicle message was in the predicted direction and represented a medium effect size, inconsistent with expectations, there were no significant relationships between the BIS traits and processing of the words in the motor vehicle message.

Table 7.22

Bivariate Correlations between the RST Traits and Social loss-framed/ Motor Vehicle Word Processing (RT) for Participants Exposed to the Mixed Condition

Scales	Motor vehicle message processing (RT)	Social processing (RT)
BIS Scales		
CC BIS	.297	.532*
J5 BIS	.027	-.116
CC Panic	.125	.384
Behavioural measure		
CARROT	-.084	-.054

Note. CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales
* $p < .001$

7.5.14 H.4b: BIS and combined message condition vs. social only message condition

A series of ANOVAs were then undertaken in which condition (i.e., social loss-framed message only versus mixed cue condition, which comprised both the social loss-framed message plus motor vehicle message) was entered as the IV, the RST traits were each entered separately as the CVs, and RT to the message words was entered separately as the DVs in each analysis. The findings revealed that BIS (as measured by CC BIS) showed a significant interaction with condition (social loss vs. mixed) on message processing. This finding is discussed below and non-significant findings presented in Appendix K.

CC BIS and condition on message processing. The main effect of BIS approached significance, $F(1, 50) = 3.63$, $p = .063$, $\eta^2 = .07$, and there was a significant BIS x condition interaction, $F(1, 50) = 4.99$, $p = .030$, $\eta^2 = .09$. The linear regression revealed that there was a significant partial positive correlation between BIS and message processing for those individuals in the mixed cue condition, $r = .532$, $p = .007$, accounting for 28.3% of the variance. The simple slopes graph (Figure 7.14) showed that individuals with higher BIS scores demonstrated slower responses times to the words from the social loss-framed message when exposed to both messages (social loss-framed message and motor vehicle message), as anticipated. There was no significant partial correlation of BIS and processing the words in the social loss-framed message for those individuals exposed only to that message, $r = .005$, $p = .808$.

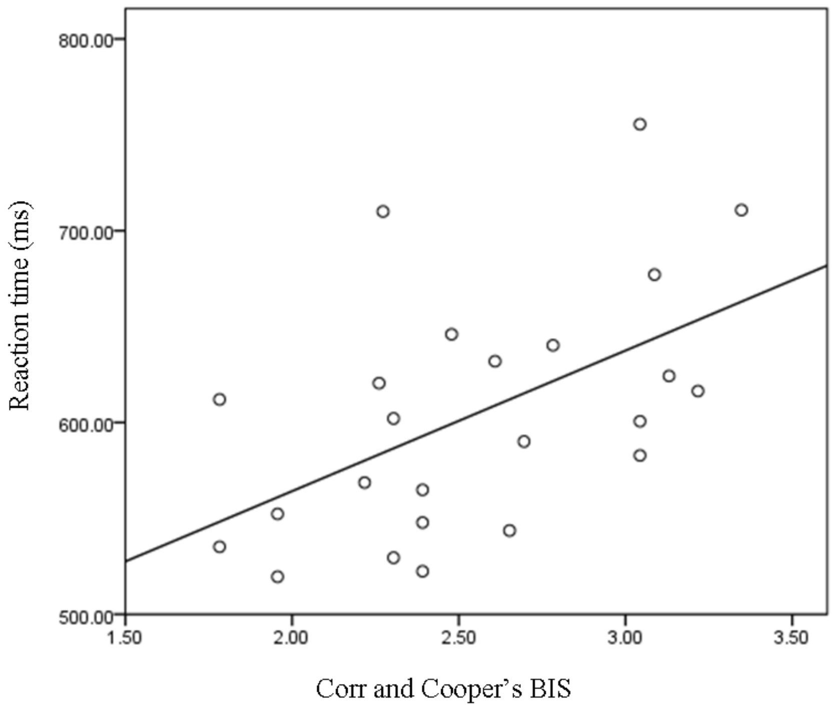

Figure 7.14. Partial correlation of CC BIS and RTs of words presented in the social loss-framed message for individuals exposed to the mixed message condition.

Overall, providing some support for H.4b, the findings indicated that stronger BIS individuals (compared to their weaker BIS counterparts, as measured by CC BIS scale) processed the social loss-framed message to a lesser extent when it was presented in conjunction with the motor vehicle message.

7.5.15 H.4c: BIS and acceptance of mixed messages

Social loss-framed road safety message and motor vehicle message. The correlation analyses revealed some significant relationships between the FFFS/ BIS traits and road safety message acceptance measures (see Table 7.23) and BAS traits and the motor vehicle message acceptance measures (see Table 7.24).

Table 7.23

Bivariate Correlations between the BIS and the FFFS Traits, Processing, and Acceptance for Participants Exposed to the Mixed Condition (N = 25)

	RS message Effective	RS message attitudes	RS message Intentions	RS message compliance	MV message Effective	MV message attitudes	MV message goals
BIS self-report scales							
CC BIS	.226	.267	.220	.134	-.037	-.040	-.170
J5 BIS	.444*	.192	.148	.303	.423*	.298	.136
FFFS self-report scales							
CC FFFS	.495*	.281	.169	.381	.136	.035	-.153
CC Panic	.560**	.399	.323	.397	.037	-.047	-.241
J5 FFFS	.270	.338	.314	.353	-.218	-.349	.353
J5 Fight	.090	.230	.243	-.047	.037	-.155	.005
J5 Flight	.328	.167	.039	.049	-.142	-.070	-.320
J5 Freezing	.114	.073	-.034	.263	-.187	-.105	-.135

Note. RS = road safety. MV = motor vehicle. CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales

** $p < .001$

* $p < .05$

Table 7.24

Bivariate Correlations between the BAS traits, Processing, and Acceptance for Participants Exposed to the Mixed Condition (N = 25)

	RS message Effective	RS message attitudes	RS message Intentions	RS message compliance	MV message Effective	MV message attitudes	MV message goals
BAS self-report scales							
CC BAS: Reward Interest	.193	.073	.015	-.003	-.111	-.092	-.049
CC BAS: Goal-Drive Persistence	.224	.086	.064	.160	-.009	.133	-.045
CC BAS: Reward Reactivity	.395	.241	.043	.120	.188	.139	.092
CC BAS: Impulsivity	-.109	.144	.071	-.202	-.049	-.161	.020
CC Defensive Fight	.153	-.053	-.071	-.035	.278	.337	.282
J5 BAS	-.170	-.105	-.114	-.284	-.172	-.015	.110
Behavioural measure							
CARROT	-.280	-.354	-.322	-.330	.014	.100	.211

Note. RS = road safety. MV = motor vehicle. CC = Corr and Cooper’s RST-PQ; J5 = Jackson-5 Scales

Specifically, as anticipated, there were moderate to strong significant relationships between several of these scales (i.e., CC FFFS, CC Panic, and Jackson's BIS) and message effectiveness. Higher CC FFFS, CC Panic, and Jackson's BIS trait scores were associated with greater perceived message effectiveness of the social loss-framed message. Further, the moderate positive correlations between CC Panic scores, J5 FFFS scores and attitudes approached significance in the predicted directions (p = .053 and p = .098, respectively). There were also moderate positive correlations between J5 Flight scores and message effectiveness, between J5 FFFS scores, J5 Flight scores and message intentions, and between CC FFFS scores, CC Panic scores, J5 FFFS scores and message compliance, although all these relationships failed to reach significance, p < .01. For the BAS traits, there was a moderate positive correlation between CC BAS: Reward Reactivity and message effectiveness and a negative moderate correlation between CARROT scores and message attitudes. Once again, these BAS and message acceptance correlations failed to reach significance (p = .056 and p = .082, respectively).

There was a significant moderate positive relationship between Jackson's BIS scores and effectiveness of the vehicle message, indicating that individuals high on this trait were more likely to report that the motor vehicle message was effective. Further, while there was a moderate positive correlation between CC Defensive Fight and attitudes towards the vehicle message, this relationship was not significant, p = .108. However, no other BAS traits showed a significant relationship with the vehicle acceptance measures. For the BIS/ FFFS traits and motor vehicle acceptance measures, the moderate negative correlation approached significance between J5 FFFS scores and attitudes, p = .088. There was a positive moderate correlation between J5 FFFS and goals towards the vehicle presented in the advertisement which approached significance, p = .083. Overall, only partial support was found for H.4c which predicted that individuals with a stronger FFFS (compared to a weaker FFFS) would demonstrate greater acceptance of the social loss-framed messages, while those with a stronger BAS would show greater acceptance of the vehicle message than those with a weaker BAS.

While not one of the hypotheses tested, to further and more comprehensively assess the influence of the BIS a series of ANOVAs were then undertaken in which condition (i.e., social loss-framed message vs. mixed cue condition) was entered as the IV, the RST traits were each entered separately as the CVs, and message acceptance was entered separately as the DVs in each analysis. These findings are discussed below, with the corresponding significant statistics presented in Table 7.25 and non-significant findings presented in Appendix L.

Table 7.25

Significant ANOVA Effects of BIS/ FFFS Traits and Condition (Social loss-framed vs. Mixed Messages) on Message Acceptance

Effect	*F*	*p*	η^2
Jackson's BIS and condition on message effectiveness (*n* = 52)			
BIS	1.86	.179	.03
Condition	9.31	.004	.16
BIS x condition	8.23	.006	.14
CC Panic and condition on message effectiveness (*n* = 51)			
Panic	7.20	.010	.11
Condition	9.61	.003	.15
Panic x condition	9.06	.004	.15
CC FFFS and condition on message effectiveness (*n* = 52)			
FFFS	4.09	.049	.09
Condition	5.65	.022	.10
FFFS x condition	4.88	.032	.08

Note. CC = Corr and Cooper's RST-PQ

Jackson's BIS and condition on message effectiveness. There was a significant main effect of condition, but no significant main effect of BIS. There was, however, a significant BIS x condition interaction. The partial correlation was significant between BIS and message effectiveness for those participants exposed to the mixed message condition, $r = .445$, $p = .026$, with the BIS accounting for 19.8% of the variance; but not for the social loss-framed only condition, $r = .279$, $p = .159$. The simple slopes graph for those exposed to the social-frame message in the mixed condition (Figure 7.15) showed that individuals with higher BIS scores were more likely to rate the social loss-framed message as effective.

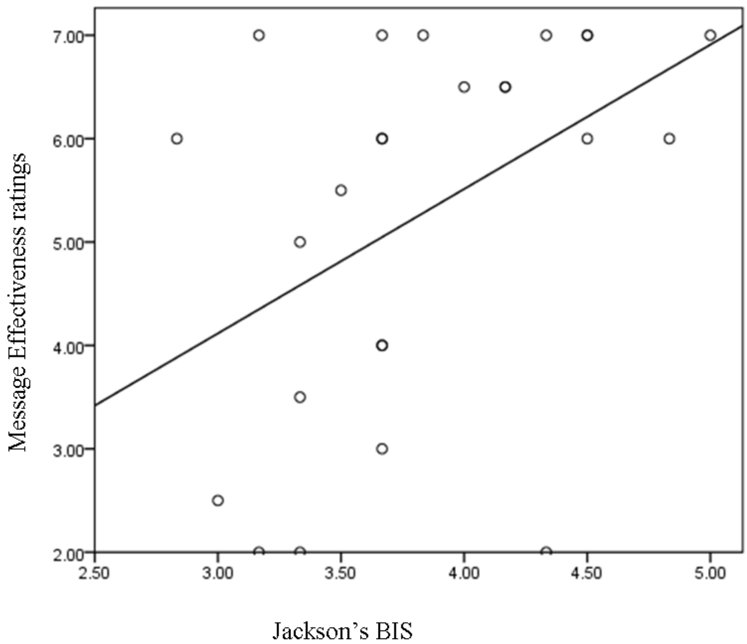

Figure 7.15. Partial correlation of Jackson's BIS and message effectiveness ratings of the social loss-framed message for individuals exposed to the mixed message condition.

CC Panic and condition on message effectiveness. There was a significant main effect of Panic, indicating that higher Panic scores were associated with higher ratings of message effectiveness, for both message conditions (see Figure 7.16). There was also a significant Panic x condition interaction. The linear regression revealed that there was a significant partial positive correlation between Panic and message effectiveness for those individuals allocated to the mixed cue condition, $r = .559$, $p = .004$, with Panic accounting for 31.3% of the variance in message effectiveness. The simple slopes graph (Figure 7.17) shows that higher panic scores were associated with greater perceived message effectiveness for those individuals who viewed both the road safety and motor vehicle messages. There was no significant partial correlation between Panic and message effectiveness for those individuals allocated to view only the social loss-framed message, $r = .063$, $p = .761$.

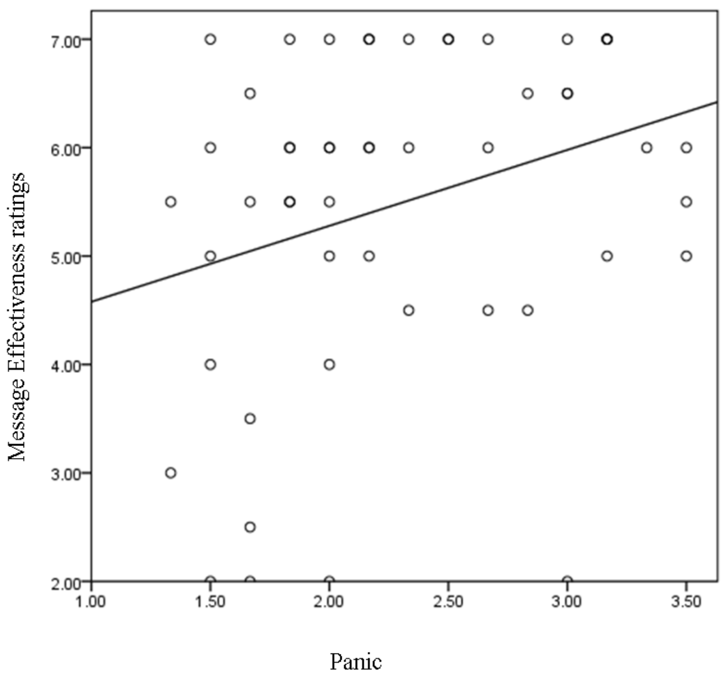

Figure 7.16. Partial correlation of CC Panic and message effectiveness ratings of the social loss-framed messages.

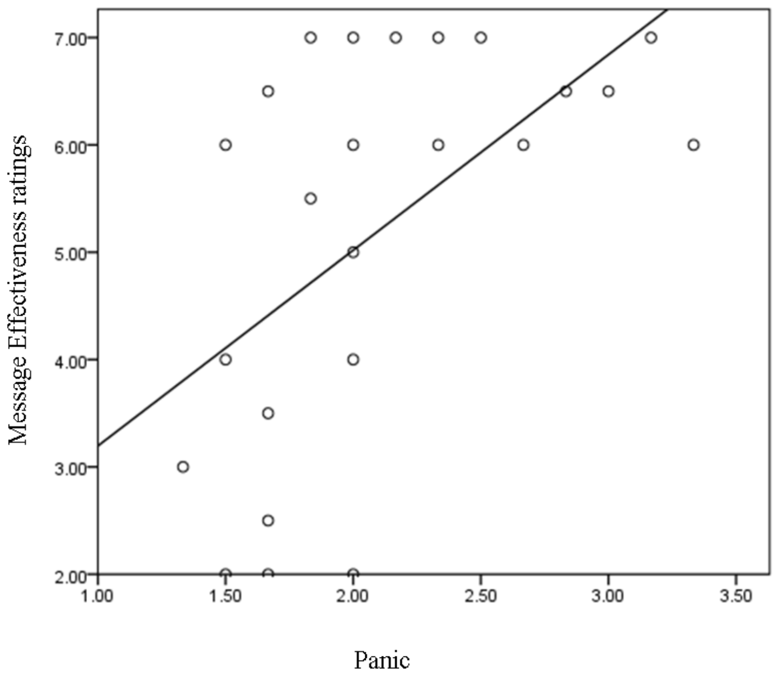

Figure 7.17. Partial correlation of CC Panic and message effectiveness ratings of the social loss-framed message for individuals exposed to the mixed message condition.

CC FFFS and condition on message effectiveness. There was a significant main effect of FFFS, indicating that higher FFFS scores were associated with higher ratings of message effectiveness, regardless of message condition (see Figure 7.18). There was also a significant FFFS x condition interaction. The partial correlation was significant for FFFS and message effectiveness for those individuals exposed to the mixed cues, r = .495, p = .012, accounting for 24.5% of variance; but not for those individuals only exposed to the social loss-framed message, r = .032, p = .881. The simple slopes graph showed that higher FFFS scores were associated with higher effectiveness ratings for the social loss-framed message by those exposed to the mixed condition (see Figure 7.19).

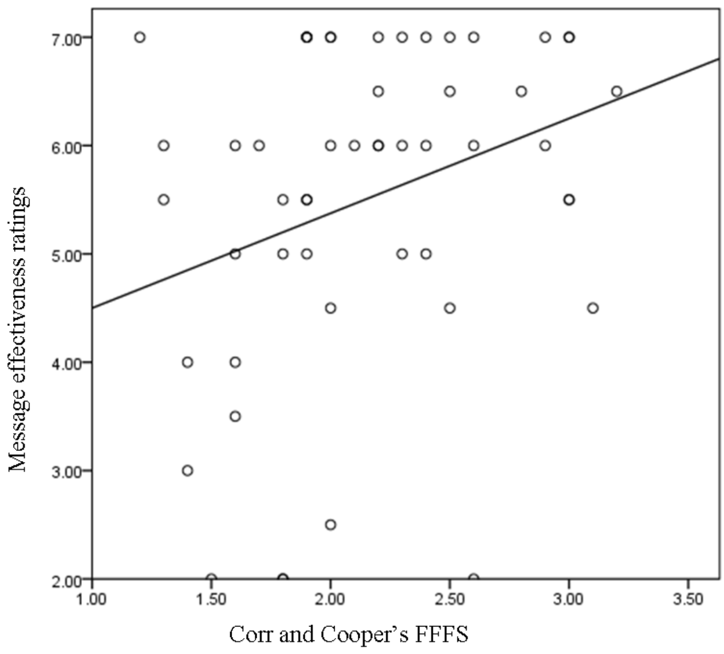

Figure 7.18. Partial correlation of CC FFFS and message effectiveness ratings for individuals exposed to the mixed message condition.

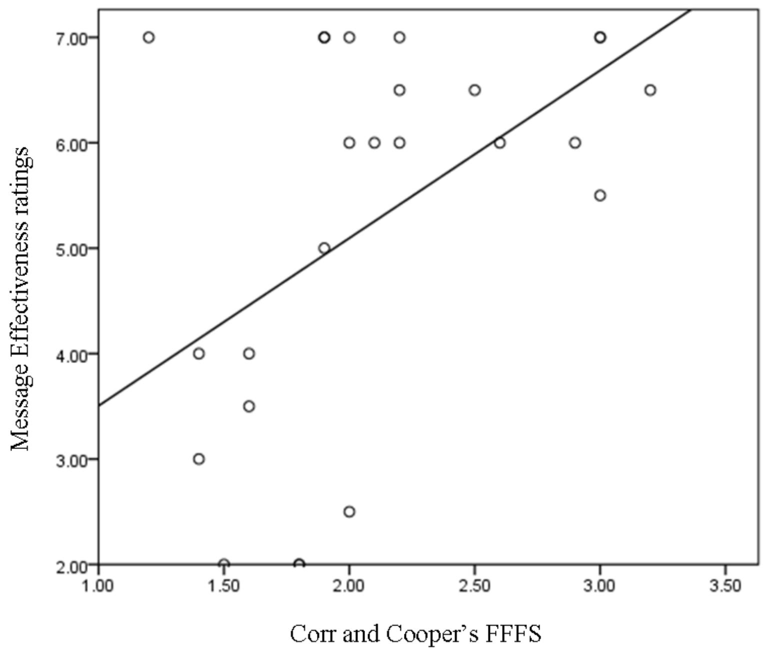

Figure 7.19. Partial correlation of CC FFFS and message effectiveness ratings of the social loss-framed message for individuals exposed to the mixed message cues.

The ANOVA findings also revealed that the main effects of CC BAS: Reward Interest on message effectiveness and Jackson's FFFS on attitudes and message compliance approached significance (see Table 7.26). There were also approaching significant trait x condition interactions for CC BAS: Reward Reactivity on message effectiveness and Jackson's Flight on message attitudes, with medium sizes. While these interactions were not significant, the simple slopes graphs showed that greater CC BAS: Reward Reactivity and Jackson's Flight scores were associated with higher ratings of message effectiveness, attitudes, respectively, for those individuals allocated to the mixed message condition.

7.5.16 H.5: Self-reported risk taking driving behaviour

Personality and risky driving behaviour. Correlation analyses were undertaken to examine if individual differences in the BAS and the FFFS traits influenced risk taking driving behaviour (see Table 7.27). Individuals with higher scores on CC BAS: Reward Interest, CC BAS: Impulsivity, and CC Defensive Fight scales were more likely to report risky driving behaviour at time 1, as expected, and at follow-up (time 2). Higher scores on CC BAS: Reward Reactivity were also associated with greater risky driving behaviour scores at time 2, one week after viewing the road safety message. These BAS findings provide some support for H.5, which predicted that individuals who are more sensitive to rewards would report greater engagement in risky driving behaviour than those individuals who are less sensitive to rewards.

Table 7.26

ANOVA Trend Effects (p < .10) of RST Traits and Condition (Social Loss-framed vs. Mixed Messages) on Message Acceptance

Effect	F	p	η^2
CC BAS Reward Interest and condition on message effectiveness (*n* = 51)			
Reward Interest	3.24	.078	.06
Condition	< 0.01	.993	.00
Reward Interest x condition	0.10	.756	.00
CC BAS Reward Reactivity and condition on message effectiveness (*n* = 51)			
Reward Reactivity	2.62	.112	.05
Condition	4.25	.045	.08
Reward Reactivity x condition	3.51	.067	.06
Jackson's FFFS and condition on attitudes (*n* = 52)			
FFFS	3.09	.085	.06
Condition	0.42	.523	.01
FFFS x condition	0.47	.498	.01
Jackson's Fight and condition on attitudes (*n* = 51)			
Fight	< 0.01	.989	.00
Condition	2.51	.120	.05
Fight x condition	2.92	.094	.06
Jackson's FFFS, condition, and gender on message compliance (*n* = 36)[52]			
FFFS	3.51	.071	.08
Condition	0.02	.897	.00
Gender	4.81	.036	.12
FFFS x condition x gender	1.95	.161	.09

Note. CC = Corr and Cooper's RST-PQ

[52] Since the preliminarily findings revealed that female drivers were more likely to report complying with the social loss-frame message than male drivers, gender was entered in as an extra CV in all analyses that examined the social loss-frame message and message compliance in the mixed cue condition to control for differences in gender that may influence RST results.

Table 7.27

Bivariate Correlations between BAS/ FFFS Traits and Self-reported Risky Driving Behaviour (measured 1 week later)

	Risky driving behaviour scores	
	Time 1	Time 2
BAS Subscales		
CC BAS: Reward Interest	.217*	.336**
CC BAS: Goal-Drive Persistence	.017	.120
CC BAS: Reward Reactivity	.068	.256*
CC BAS: Impulsivity	.272**	.278**
CC Defensive Fight	.205*	.330**
J5 BAS	.151	.300**
FFFS Subscales		
CC FFFS	.062	-.125
CC Panic	-.064	-.103
J5 FFFS	-.016	-.043
J5 Fight	.287**	.374**
J5 Flight	-.076	.024
J5 Freezing	-.089	-.298**

Note. CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales
** $p < .001$
* $p < .05$

For the FFFS traits, higher scores on Jackson's Fight scale were more likely to report risky driving behaviour at time 1 and at follow-up (time 2). However, there was a significant moderate negative relationship between Jackson's Freezing scale and self-reported speeding behaviour at time 2, indicating that individuals with stronger Freezing traits were less likely to report risky driving behaviour. These findings may suggest that the Fight and Freezing traits (which form part of the FFFS) measure different behavioural constructs.

7.5.17 H.6: Optimism bias

One sample *t*-tests were first undertaken to assess the presence of optimism bias in the current sample of young drivers. Consistent with previous research (see Harrè et al., 2005), a *t*-test value of 4 was used as the midpoint to evaluate optimism bias. Compared to 'a typical young driver', this sample of young drivers perceived themselves to be significantly more skilful (M = 4.93, SD = 0.95), $t(131) = 11.26$, $p < .001$, 95% CI [0.77, 1.10], $\eta^2 = .49$, safer

(M = 5.21, SD = 1.08), $t(131) = 12.84$, $p < .001$, 95% CI [1.03, 1.40], $\eta^2 = .56$, and to have greater on-road driving experience (M = 4.72, SD = 1.23), $t(131) = 6.72$, $p < .001$, 95% CI [0.51, 0.93], $\eta^2 = .09$. Further, the participants also perceived themselves to be significantly less risky (M = 2.95, SD = 1.33), $t(131) = -9.12$, $p < .001$, 95% CI [-1.28, -0.82], $\eta^2 = .16$, and less likely to be involved in a speed related crash (M = 2.53, SD = 1.23), $t(131) = -13.70$, $p < .001$, 95% CI [-1.68, -1.26], $\eta^2 = .26$, than 'a typical young driver'.

RST and Optimism bias. Correlation analyses assessed the potential influence of RST traits on optimism bias (see Table 7.28). The results revealed that there were significant weak to moderate positive relationships between CC BAS: Impulsivity and risky driving behaviour and between CC Defensive Fight scales and risky driving behaviour, indicating that individuals high on these traits were more likely to rate themselves as more risky than the average young driver. There was also a significant weak negative relationship between CC BAS: Impulsivity and safe driving behaviour, indicating that individuals with higher impulsivity scores reported less safe on-road behaviour. Further, along with CC BAS: Reward Interest and Jackson's BAS scales, individuals high on these BAS traits rated themselves as having greater speed-related crash risk compared to 'a typical young driver'. These findings indicate that those who were more sensitive to rewards were more aware of the negative consequences related to their greater prosperity for risky driving behaviour. These findings were inconsistent with H.6, which predicted that individuals with higher BAS traits would demonstrate greater driving-related optimism bias. However, a significant weak positive relationship between CC Defensive Fight and driving skills, revealed that individuals with higher CC Defensive Fight scores were likely to perceive themselves to be more skilful than 'a typical young driver', a finding that is consistent with this hypothesis.[53]

[53] Corr and Cooper's Defensive Fight was developed separately from the BAS, the FFFS, and the BIS Scales.

Table 7.28

Bivariate Correlations between BAS/ FFFS Traits and Optimism Bias Items (N = 133)

	Skilful	Safe	Experience	Risky	Crash
BAS Subscales					
CC BAS: Reward Interest	.080	-.122	.111	.095	.174*
CC BAS: Goal-Drive Persistence	.078	-.041	.150	-.051	.005
CC BAS: Reward Reactivity	.058	.020	.055	.000	-.037
CC BAS: Impulsivity	-.025	-.241*	-.044	.299**	.322**
CC Defensive Fight	.225**	.037	.131	.227**	.177*
J5 BAS	.147	-.010	-.025	.113	.200*
FFFS Subscales					
CC FFFS	-.033	-.016	.008	-.014	.031
CC Panic	-.056	-.042	.029	-.032	-.046
J5 FFFS	-.101	-.054	.021	.109	.055
J5 Fight	.198*	.006	.182*	.248**	.186*
J5 Flight	.015	-.002	.093	-.026	-.119
J5 Freezing	-.218*	-.129	-.090	.070	.044

Note. CW = Carver and White BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales
** $p < .001$
* $p < .05$

Similar to the BAS trait findings, there was a significant weak to moderate positive relationship between Jackson's Fight and two optimism bias items: risky driving behaviour and speed related crash risk. Specifically, individuals with higher Fight scores perceived themselves to be more risky and to have a greater crash risk than 'a typical young driver'. However, the significant weak positive relationships between Fight and driving skills and between Fight and driving experience, also revealed that these individuals also perceived themselves to be more skilful and have greater driving experience than 'a typical young driver'. Finally, there was a significant weak negative relationship between Jackson's Freezing scale and driving skills, revealing that individuals higher on Freezing are less likely to perceive themselves to be more skilful than 'a typical young driver'.

7.5.18 H.7: Gender and risky driving behaviours

A series of independent group *t*-tests were conducted to examine if male and female participants differed in self-reported risky driving behaviours at time 1 and time 2. The effect of gender approached significance for self-reported risky driving behaviour between male (M = 2.21, SD = 0.64) and female drivers (M = 1.99, SD = 0.63) at time 1, $t(130) = 1.78$, p = .077, 95% CI [-0.02, 0.47], $\eta^2 = .02$, with male drivers reporting higher risk taking behaviours than female drivers. At time 2, male drivers (M = 2.18, SD = 0.81) reported significantly greater engagement in risky driving behaviours than female drivers (M = 1.67, SD = 0.56), $t(87) = 3.29$, p = .001, 95% CI [0.20, 0.82], $\eta^2 = .11$. These results provide some support for H.7, indicating that young male drivers may be more likely to participate in riskier driving behaviours compared to their female counterparts.

7.5.19 H.8: Gender and Optimism bias

Independent groups *t*-tests were then conducted to assess if optimism bias ratings differed by gender. As expected, male drivers (M = 5.29, SD = 0.93) showed greater optimism bias in terms of their skilfulness than did female drivers (M = 4.80, SD = 0.93),

$t(130) = 2.63$, $p = .010$, 95% CI [0.12, 0.84], $\eta^2 = .05$. However, inconsistent with expectations, there were no other significant gender effects on optimism bias (see Table 7.29). As such, the findings only partially support H.8, for one item, which predicted that male drivers would demonstrate more driving related optimism bias than female drivers

Table 7.29

Gender Differences in Optimism Bias

Variable	*n*	*M (SD)*	*t*	*p*	95% CI	η^2
Safe						
Male	35	5.46 (1.20)				
Female	97	4.12 (1.03)	1.57	.119	-0.09, 0.75	.02
Experience						
Male	35	5.00 (1.46)				
Female	97	4.62 (1.13)	1.58	.117	-0.10, 0.86	.02
Risky						
Male	35	3.00 (1.50)				
Female	97	2.93 (1.27)	0.28	.784	-0.45, 0.59	.00
Crash risk						
Male	35	2.74 (1.48)				
Female	97	2.45 (1.13)	1.19	.235	-0.19, 0.77	.01

Note. CI = Confidence Interval. Higher means on Safe and Experience scale items and lower scores on Risky and Crash risk scale items indicate greater self-enhancement bias.

7.5.20 H.9: Gender and TPE

A series of independent groups *t*-tests were conducted to assess if gender influenced individuals' TPE responses towards the messages (i.e., if they perceived that the message was intended for people like themselves or if they perceived the message to be intended for others). There were no significant differences in perceptual bias between male ($M = 5.33$, $SD = 1.51$) [54] and female ($M = 3.85$, $SD = 1.90$) responses towards the physical gain-framed

[54] A 9-point semantic scale was used to examine the TPE where, 1 = *the message was intended for people like me*, 9 = *this message was intended for others*.

message, $t(24) = 1.75$, $p = .093$, 95% CI [-0.27, 3.23], $\eta^2 = .11$, or between male ($M = 2.33$, $SD = 0.58$) and female ($M = 3.67$, $SD = 1.93$) responses towards the physical loss-framed message, $t(25) = -1.17$, $p = .251$, 95% CI [-3.67, 1.01], $\eta^2 = .10$. As such, these findings did not support H.9, which predicted that male drivers would perceive other people (i.e., third persons) would be more persuaded by the physical loss-framed message, while female drivers would perceive that the physical loss-framed message would influence themselves more so than others.

However, for the social messages, male drivers ($M = 2.75$, $SD = 2.36$) were more likely to perceive that the social loss-framed was intended for people like them (than for others) than female drivers ($M = 4.87$, $SD = 1.77$), $t(25) = -2.12$, $p = .044$, 95% CI [-4.18, -0.06], $\eta^2 = .20$. Conversely, female drivers ($M = 3.11$, $SD = 1.41$) were more likely to perceive that the social gain-framed message was intended for people like them (than for others) than male drivers ($M = 4.67$, $SD = 1.87$), $t(25) = 2.42$, $p = .023$, 95% CI [0.23, 2.88], $\eta^2 = .19$.

7.6 Discussion

The purpose of this study was to assess if individual differences in Gray and McNaughton's RST traits influenced processing and subsequent acceptance of road safety messages and motor vehicle stimuli. Overall, the findings did not support the BAS and FFFS hypotheses. However, the results provided some support for the influence of BAS in gain-framed messages whereby a stronger CC BAS: Impulsivity trait was associated with greater effectiveness of the physical gain-framed message and a stronger CC BAS: Goal-Drive Persistence trait was related to more favourable attitudes towards the social gain-framed message. The results also provided some support for the BIS hypothesis. For instance, individuals with a stronger CC BIS showed greater inhibition in their reaction times towards the social loss-framed message stimuli when allocated to the mixed cue condition than the message only condition. Independent of personality, the findings revealed that that the current sample perceived that other young drivers were more susceptible to driving related optimism biases. Male drivers were more likely to perceive that the social loss-framed message was intended for people like them (than for others) compared to female drivers. The following section first discusses the BAS and the FFFS trait findings, followed by the BIS trait findings. Perceptual bias and risky driving behaviour findings are then discussed, prior to the limitations and implications of the current study's findings.

7.6.1 Relationship between the BAS, message processing, and acceptance of the gain-framed messages

Correlations and mediation analyses were used to examine if individuals who were more sensitive to reward cues (compared to those less sensitive to reward cues) would demonstrate a greater cognitive bias towards the gain-framed anti-speeding messages and be more likely to subsequently accept these messages. While there were some significant moderate positive relationships between the BAS traits and message acceptance measures (as predicted), there were a mixture of inconsistent weak negative and positive correlations between the BAS traits and message processing, all of which failed to reach significance and typically yielded weak effect sizes. Thus, inconsistent with predictions (H.1), individual differences in BAS did not significantly influence processing of the gain-framed messages.

The BAS is activated by reward stimuli and previous research has reported that individuals sensitive to rewards have a stronger desire to approach reward cues than those with a weaker reward system (e.g., Franken, 2002). Inconsistent with the theoretical predictions of the RST, the current findings revealed that participants did not demonstrate a processing bias for the messages that were congruent with their respective motivational system, results which are inconsistent with previous literature (e.g., Kaye et al., 2013). For instance, Kaye et al. (2013) found that processing mediated the relationship between BAS (as measured by Carver and White's total BAS) and message effectiveness of the physical gain-framed message. However, in contrast to Kaye et al. (2013), Study 2 assessed each of the BAS components individually (instead of a total BAS score) and only tested young drivers (compared to the previous sample of drivers aged 17 to 54 years of age in Kaye et al.). Consistent with previous reports that young drivers are more likely to report speeding behaviour than older drivers (e.g., Fleiter et al., 2006), more than half of the drivers in the current sample reported regular speeding behaviour (63.1%) compared to 48.2% of drivers in Kaye et al.'s study. Accordingly, they may have been more inclined to process and accept the physical gain-framed message, as this message was more consistent with the majority of drivers' actual driving behaviour (i.e., abiding by the speed limit).

An additional explanation for the differences in results between the two studies may lie in the message stimuli. In the present study, the message stimuli were adjusted based on the feedback from young drivers (Study 1c, chapter 6, section 6.13). Specifically, word changes were made to the physical messages to exclude the perceived social cues ("... and your loved ones" and "... you and your passengers") and to match word valence between the physical and social message conditions. These changes may have affected how the message stimuli were perceived by the current sample (i.e., they may have found the overall message to be less effective) and potentially, could account for the different BAS and physical message effectiveness findings observed. The changes may have led to a decreased sensitivity to detect any BAS effects.

The results indicated that, for the gain-framed messages, there were some significant relationships between the BAS traits and self-report message acceptance measures. Specifically, individuals with higher CC BAS: Goal-Drive Persistence ratings were more likely to report more favourable attitudes towards the physical gain-framed message and individuals with higher CC BAS: Impulsivity ratings perceived the physical gain-framed message to be more effective than those with lower ratings on these corresponding traits. For the social gain-framed message condition, individuals with higher CC BAS: Goal-Drive Persistence scores demonstrated more favourable attitudes towards this message and greater intentions to comply with this message then individuals with lower CC BAS: Goal-Drive Persistence ratings. Consistent with previous research that has examined the relative effectiveness of message frames by the BAS trait (e.g., Mann et al., 2004; Sherman et al., 2006), these findings indicated that reward sensitive traits may influence message acceptance.

Despite the inconsistent BAS effects, from a theoretical perceptive the current study adds to the existing literature. For instance, previous research in the health communication field has typically examined one global measure of the BAS. However, by assessing the individual BAS facets in the current program of research, it was revealed that these underlying BAS processes did not influence processing of the gain-framed anti-speeding messages. Furthermore, the current findings revealed that only two BAS facets were associated with message acceptance. Given that each of the underlying BAS processes represents a different behavioural response (e.g., goal pursuit for Goal-Drive Persistence and non-planning or lack of restraint for Impulsivity; Corr & Cooper, 2013) it is not surprising then, that the individual BAS responses could potentially be associated with different message acceptance outcomes.

Voigt et al. (2009), for instance, examined the influence of Carver and White's (1994) three BAS facets (i.e., Drive, Reward Responsiveness, and Fun Seeking) on various risky health behaviours (e.g., alcohol use, drug use, physical inactivity, and poor diet). Their findings revealed that the three BAS processes were associated with different health behaviours. For instance, higher BAS: Fun Seeking scores were associated with higher self-reported alcohol and drug use, however, a similar relationship was not evident between BAS: Reward Reactivity and these two risky health behaviours. Consistent with Study 2, these findings highlight the need to further examine the individual BAS responses in relation to risky health behaviours and in the current context, acceptance of road safety messages designed to encourage individuals to adopt safer driving habits.

Despite this potential explanation for the discrepant BAS, message processing, and message acceptance findings, the lack of significant findings may be potentially due to the type of cognitive task and message stimuli used to in this study. For instance, the LDT may not be a sufficiently sensitive measure to assess cognitive processing in the current sample of young drivers and a more sensitive processing measure, such as ERPs, may need to be implemented. Further, the message stimuli may not have been salient enough to activate the BAS in the current younger sample and more rewarding stimuli may be required to activate this system.

Cognitive processing. One potential reason for the lack of significant repetition priming effects may relate to the different contexts that the prime words (i.e., within message) and target words (i.e., individually, within the LDT) were presented to participants.

For instance, participants may have focused on the context of the different framed messages (e.g., gain-framed vs. loss-framed), rather than the specific individual words and as a result such a tendency may have failed to produce priming effects. Similar to Study 2, Oliphant (1983) asked participants to read a set of experiment instructions which contained 15 words that were later repeated in a LDT. Oliphant's findings revealed that reading the words in the experiment instructions failed to produce repetition priming effects when participants were exposed to the same word stimuli in the LDT. These findings suggest that context may influence repetition priming effects The LDT task used here was designed to assess differential processing of the previously viewed message words. Based on the underlying concept of spreading activation theory (see chapter 5), words that had been previously primed by message exposure should elicit faster RTs than words not presented in the preceding message, despite individual differences in RST traits. However, the findings revealed that there were no significant differences in mean RTs for the words in the message that participants had been exposed to compared to the words in the alternative message conditions that participants had not viewed. These RT findings may suggest that this sample demonstrated a lack of attention towards the message during the experiment and consequently, did not process the anti-speeding message.

Previous research has reported that ERPs may be a more sensitive measure of cognitive processing than behavioural measures. More specifically, ERPs are able to detect early neural processing (i.e., < 150ms after stimulus onset) and are not influenced by participants' motor control responses (e.g., Thorpe, Fize, & Marlot, 1996). In the current younger sample, the LDT may not have been sufficiently sensitive to assess earlier attentional/ processing responses. Arguably, this reasoning may explain why the LDT was able to detect goal conflict between the mixed message cues (assessed via slower RTs) than word processing biases as a function of the FFFS and BAS traits, whereby faster RTs indicated greater message processing.

A further explanation for the findings of somewhat discrepant RT to message words is the possibility of a ceiling effect. Whilst the RT data were normally distributed, individuals with a stronger BAS (or a stronger FFFS in the loss-framed condition) may have demonstrated faster RTs to all words, despite the message condition. For instance, Hultsch, MacDonald, and Dixon (2002) reported that compared to older aged groups (i.e., those aged 65 years and older), younger adults aged 17 to 36 years demonstrated faster RTs and showed reduced variability in RTs on a word/ non-word LDT. Thus, in the current study, word processing findings may be the result of reduced variability in word RTs and, as such, potential BAS and FFFS effects towards the message stimuli may not be evident. These explanations are speculative, however, and future research should further examine the use of experimental behavioural tasks in the context of processing, as a function of the RST traits and age differences.

Message word stimuli. An alternative explanation for the absence of significant effects of RST traits on message processing and message acceptance may be due to the message word stimuli. While the words in each message condition were matched in terms of frequency, a large proportion of the words had high frequency scores, indicating that they are commonly used in the English language (see Brysbaert & New, 2009). While individuals are quicker to respond to high frequency words compared to low frequency words (e.g., Coane & Balota, 2010), previous research that has examined long-term repetition effects have reported that low frequency words result in greater repetition effects than high frequency words (e.g., Forster & Davis, 1984; Lowder et al., 2013). The lack of repetition priming effects in Study 2 may be due to word frequency (see chapter 6, tables 6.2 to 6.4, for word frequency ratings). In terms of RST-based expectations, word frequency may have contributed to a ceiling effect on RT in the LDT, preventing the detection of any BAS (or FFFS) effects. This possibility seems plausible to the extent that some significant positive relationships were found between the BAS (and FFFS) and message acceptance measures, but no significant relationships were found between the BAS and processing of the gain-framed messages (or between FFFS and processing of the loss-framed messages).

Alternatively, pictorial stimuli may be more suitable to activate the BAS and the FFFS in the context of road safety advertising than written concepts. Visual images have been reported to be more persuasive at reducing negative health behaviours, such as smoking, than text-only anti-smoking messages (see Hammond, 2011, for a review of health warning messages). Further, in a road safety advertising context, young drivers may be more likely to be exposed to visual road safety advertisements than written advertisements and pictorial stimuli may therefore have higher ecological validity than text-only messages. Study 3 therefore assessed if individual differences in BAS and FFFS traits influenced young drivers' processing (measured via ERPs) towards a range of still positive and negative picture images used in actual Australian road safety advertisements.

7.6.2 Relationship between the FFFS, message processing, and acceptance of the loss-framed messages

Correlations and mediation analyses examined if individuals who were more sensitive to punishment cues (compared to those less sensitive to punishment) would demonstrate a processing bias towards the loss-framed anti-speeding messages and subsequently, be more likely to accept these messages. There were a mixture of weak to moderate negative and positive correlations between the FFFS traits and processing for the loss-framed messages which, similar to the BAS and gain-framed message findings, failed to reach significance and typically produced weak effect sizes (see Tabachnick & Fidell, 2007). Thus, inconsistent with predictions (H.2), individual differences in FFFS did not influence processing biases towards the physical and social loss-framed anti-speeding messages.

The FFFS is activated by punishment cues and results in avoidance behaviour (Gray & McNaughton, 2000). This system is associated with the emotional response of fear and in a clinical context, maps onto phobia and panic disorders (Corr & Cooper, 2013). In the current study, physical and social loss-framed messages were used to activate the FFFS. However, and not supportive of the theoretical predictions of the FFFS, the findings revealed that individuals who reported a stronger FFFS did not process the loss-framed messages to a greater extent than individuals who reported a weaker FFFS. While similar terminology (e.g., death and injury) used in the current loss-framed messages was consistent with the terminology used in current threat-based road safety campaigns, it could be argued that the loss-framed messages were not perceived to be sufficiently threatening and hence, did not lead to a fear response. Alternatively, and consistent with the current perceptual bias findings, this sample of young drivers might have perceived that the messages were intended for other drivers rather than themselves and as such, the current sample of young drivers may not have sufficiently processed the content presented in these messages.

As discussed in chapter 2 (section 2.2.3) the FFFS comprises of three motivational responses: Fight, Flight, and Freeze. Whilst the FFFS has been identified to be associated with punishment-avoidance behaviour, previous research has reported a closer association between the Flight and Freeze responses than either the Fight and Flight or the Fight and Freeze responses (e.g., De Pascalis et al., 1996; Ignjatović & Todorovski. 2010). Despite the lack of significant findings in the current study, inspection of the direction of the FFFS correlations for the physical loss-framed message showed that while there was a moderate positive correlation between Jackson’s Fight and RT to the words presented in this loss-framed message, there were weak negative correlations for both Jackson’s Fight and Freeze scores and RT to the words presented in the physical loss-framed message. Thus, this study highlights the need for further research to examine the independent FFFS processes and to assess if the Fight, Flight, and Freeze systems map onto the same or different constructs.

There were, however, some significant relationships observed between the FFFS traits and the message acceptance measures. For instance, stronger Flight and Freeze traits (as measured by Jackson's scales) predicted more favourable attitudes towards the physical loss-framed message. Further, stronger Freeze trait scores predicted greater intentions to comply with the physical loss-framed message. This relationship, however, did not extend to reported message compliance, indicating that intentions to comply with the physical loss-framed message failed to lead to behaviour change. Differences in the individual FFFS responses in relation to the message acceptance items once again emphasize the need to examine the individual FFFS responses rather than the whole FFFS construct. By continuing to examine the individual FFFS responses, future research in the health communication area may be able to identify which of the FFFS processes could be effectively targeted through message design.

Similar to Kaye et al. (2013) there were no significant relationships between the FFFS traits and message acceptance of the social loss-framed message. One possible explanation for the current study's results may be due to gender; specifically, a larger proportion of female drivers (n = 23) were randomly allocated to view the social loss-framed message than male drivers (n = 4). The qualitative findings from Study 1c revealed that the female participants were less inclined to report the social loss-framed message to be effective than the male participants. Further, in Study 2, females were more likely than males to perceive that the social loss-framed message was designed to target other road users than themselves. Previous research has also reported that while female drivers are more persuaded by physical threats (Goldenbeld et al., 2008), male drivers may be more persuaded by social threat road safety messages (Lewis et al., 2008b, 2009). Thus, irrespective of differences in FFFS traits,[55] females may have not been persuaded by the social loss-framed message.

To the best of the candidate's knowledge, this was one of the first studies to examine the relationships between the revised RST traits and their processes, message processing, and message acceptance. Previous research which has explored the relative effectiveness of message frames in other health behaviour contexts by Gray's original BAS and BIS traits has consistently found that individuals more sensitive to rewards are more likely to comply with gain-framed messages and individuals more sensitive to punishments are more likely to comply with loss-framed messages (e.g., Mann et al., 2004; Shen & Dillard, 2009; Sherman et al., 2006). The current findings may call into question if similar results are evident when applying the revised RST. For instance, while the previous research has reported that responses to health messages may differ as a function of RST traits, the current findings showed no consistent BAS/ FFFS effects. As such, it may be possible that BAS/ FFFS are dependent upon specific message conditions and/or behaviours. On the basis of these inconsistent findings between Study 2 and previous research, more research is required to examine the relative effectiveness of message frames by the revised RST traits across various health communication campaigns to further examine the nature of these associated effects.

7.6.3 Message framing effects

There was mixed support for H.3, which predicted that stronger BAS traits would show greater processing of the gain-framed messages compared to the loss-framed message, while stronger FFFS traits would show greater processing of the loss-framed messages compared to the gain-framed messages. In support of these predictions, CC BAS: Impulsivity interacted with message frame for the physical conditions on message effectiveness.

[55] Despite female drivers scoring significantly higher on FFFS traits than male drivers (with the exception of Jackson's Fight scale; see Table M.1, Appendix M), there was similar variability between females' and males' FFFS scores.

Specifically, individuals with higher CC BAS: Impulsivity perceived the physical gain-framed message as more effective than individuals with lower CC BAS: Impulsivity, while no differences were observed for the physical loss-framed message by CC BAS: Impulsivity. Further, CC BAS: Goal-Drive Persistence interacted with the social framing on attitudes, whereby those with higher CC BAS: Goal-Drive Persistence reported more favourable attitudes towards the social gain-framed message than those with lower CC BAS: Goal-Drive Persistence. Again, no differences were observed for the physical loss-framed message by CC BAS: Goal-Drive Persistence. Inconsistent with predictions, however, there were no significant FFFS x framing effects on message processing or acceptance and the only interaction that approached significance (i.e., CC Panic x framing on message compliance) was not in the anticipated direction; higher CC Panic scores were associated with lower message compliance ratings of the social loss-framed message, with a medium effect size.

Impulsivity is associated with risk taking behaviour, particularly among young adults (e.g., Dunne, Freedlander, Coleman, & Katz, 2013; Stanford, Greve, Boudreaux, Mathias, & Brumbelow, 1996). Individuals high on this trait are also more likely to participate in risk taking behaviour without considering the potential negative consequences that may be associated with that risk (Zuckerman & Kuhlman, 2000). In Study 2, and consistent with previous research (Constantinou et al., 2011), individuals with higher levels of BAS: Impulsivity traits were more likely to report risky speed-related behaviours than those individuals with lower levels of BAS: Impulsivity traits, both at time 1 and one week after message exposure, at time 2.

While previous research has reported a strong positive relationship between perceived message effectiveness and actual message effectiveness (Dillard et al., 2007a, 2007b), there were no significant associations between impulsivity and reported message compliance (at time 2). Thus, although individuals with higher impulsivity scores reported greater message effectiveness of the physical gain-framed message (compared to the physical loss-framed message), these individuals were no more likely to comply with the physical gain-framed message than individuals with less impulsivity as self-reported at time 2.

One potential explanation for this difference between message effectiveness and reported message compliance may be the novelty aspect of the gain-framed message, compared to more traditional threat-based road safety campaigns. The findings from Study 1c (chapter 6, section 6.12.2), indicated that some participants reported that previous exposure to physical threats in the physical loss-framed message reduced the persuasiveness of this message. Specifically, some drivers felt somewhat desensitised to the physical consequences portrayed in the loss-framed message due to previous exposure to similar types of messages. Previous research has reported that individuals with a stronger BAS are more likely to seek out novel stimuli (i.e., Mardaga & Hansenne, 2007; Quilty, Oakman, & Farvolden, 2007) and that those with higher impulsivity traits are particularly vulnerable to novelty seeking (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). Higher impulsivity individuals may have reported the physical gain-framed message (compared to the physical loss-framed message) to be more effective as young drivers are not typically exposed to positive/ gain-framed road safety messages. Thus, considering that impulsivity may indirectly influence risky driving behaviour, more targeted gain-framed messages could be devised to target this high risk group. However, while the current findings provided some support that those with higher impulsivity are more likely to perceived gain-framed messages to be effective (over loss-framed messages), future research is required to examine how messages that are perceived to be effective may lead to actual behaviour change for this high risk group.

CC BAS: Goal-Drive Persistence was also found to influence acceptance of the gain-framed message. The Goal-Drive Persistence component of the BAS is an early approach behaviour that involves goal planning as well as the ongoing motivation that is required to achieve one's goal (see chapter 2; Corr & Cooper, 2013). In the current study, individuals with higher Goal-Drive Persistence ratings showed more favourable attitudes towards the social gain-framed message than the social loss-framed message. However, despite these favourable attitudes towards this message frame, individuals again did not alter their behaviour in accordance with the message (i.e., message compliance). Drawing upon a theoretical model in social psychology, the Theory of Planned Behaviour (Ajzen, 1991), attitudes and actual behaviour are mediated by behavioural intentions. Thus, while individuals with higher CC BAS: Goal-Drive Persistence scores reported more favourable attitudes towards the social gain-framed message (than the corresponding loss-framed message), these pre-existing attitudes failed to influence their intentions to comply with the recommendations of the message and subsequently, message compliance.

A potential explanation for these somewhat discrepant message acceptance findings may also relate to personal relevance. Specifically, in Study 1c (see chapter 6, section 6.12.2), young drivers expressed concern for protecting their family and friends (i.e., the focus of the social gain-framed message) and consequently, perceived this message to be more personally relevant than those messages that focused on other people. Accordingly, while many young drivers may plan and are motivated to protect their family and friends (i.e., potentially, high CC BAS: Goal-Drive Persistence) and thus, demonstrate favourable attitudes towards the message content, the message might not be salient enough to influence behavioural intentions and subsequent driving behaviour. Consistent with previous research (e.g., Gosselin et al., 2010; Harrè & Sibley, 2007; White et al., 2011), the current findings also showed that young drivers were susceptible to driving related optimism bias. While there were no specific significant relationships observed between CC BAS: Goal-Drive Persistence and the five optimism bias items, overall, young drivers perceived themselves to be safer, more experienced, and more skilled than the average young driver. Conversely, these young drivers were also more likely to rate themselves as less risky and less likely to be involved in a speed-related crash than the average young driver. Thus, while individuals may show favourable attitudes towards the social gain-framed message, they may perceive that the message is not relevant to their own driving behaviour.

7.6.4 The BIS and mixed message cues

Message processing. Consistent with predictions (H.4a), individuals with a stronger BIS (as assessed by CC BIS scales) demonstrated slower RTs (i.e., avoidant/ inhibited behavioural responses) to the words from the social loss-framed message. Further, and in line with H.4b, the findings also revealed that individuals with stronger CC BIS scores showed inhibited responses towards the social loss-framed message when allocated to the mixed cue condition than the message only condition. Not supportive of H.4a, however, there were a mixture of inconsistent weak negative and positive correlations between the BIS traits and processing of the words from the motor vehicle message, all of which failed to reach significance and produced small effect sizes.

The BIS is associated with the emotional state of anxiety and activated on processing conflict cues (Gray & McNaughton, 2000; see chapter 2). Consistent with the theoretical predictions of the RST, individuals with a stronger BIS demonstrated inhibited responses to the social loss-framed message when it was paired with the motor vehicle message (than when presented alone). These findings are consistent with both the revised RST concept of the BIS (see Corr, 2008; Gray & McNaughton, 2000) and with previous research findings that individuals with stronger anxiety traits are more likely to demonstrate attentional avoidance biases towards negative/ threat-based word and picture stimuli (see Bar-Haim, Lamy, Pergamin, Barkermans-Kranenburg, van Ijzendroorn, 2007; MacLeod & Matthews, 1988).

However, while CC: BIS scales showed an expected relationship on presentation of the conflicting cues, there was no such similar significant association observed between Jackson's BIS scores and message processing. This could be due to the different relationships between these two BIS scales. For instance, there was a strong significant positive relationship between CW BIS: Anxiety[56] and CC BIS, indicating that these two BIS scales reflect similar constructs. In contrast, there was a weak significant positive relationship between Jackson's BIS and CW BIS: Anxiety and between Jackson's BIS and CC BIS, thus suggesting that Jackson's BIS construct is not as closely related as the other two BIS constructs. Further research is required to compare and contrast these BIS measures to explore which measure(s) are best suited to reflect the revised BIS.

Finally in Study 2, slower RTs to the mixed message words were interpreted as avoidant/ inhibited behavioural responses of the social loss-framed message and motor vehicle message. However, there may be a further possible explanation as to why individuals with stronger BIS traits (compared to weaker BIS traits) showed slower RTs to the words in the mixed cue condition. Instead of message processing, these findings may reflect memory load (i.e., slower reaction to the words in the LDT as participants allocated to the mixed cue condition were pre-exposed to 24 words that reappeared in the LDT compared to 12 words in the message only conditions). Thus, more research is required to further assess if the current findings reflect inhibition of motor responses (consistent with current BIS predictions) or alternatively, if findings are the result of other factors, such as memory load.

Message acceptance. H.4c predicted that upon activation of the BIS, individuals would generate either a FFFS-mediated response (i.e., accept the social loss-framed message) or a BAS-mediated response (i.e., accept the motor vehicle message). As expected, stronger

[56] Similar to CC BIS, individuals with a stronger CW BIS: Anxiety demonstrated slower RTs to the words from the social loss-framed message (see Appendix D).

CC FFFS scores predicted greater effectiveness ratings for the social loss-framed message. While not significant, there were also several moderate positive correlations in the predicted direction between the FFFS traits (i.e., J5 FFFS, J5 Fight, J5 Flight, and CC Panic) and the four message acceptance measures, with medium effect sizes. These FFFS findings may be due to small cell sizes and thus, limited power.

The results also revealed that higher Jackson's BIS scores were also predictive of greater effectiveness ratings for the social loss-framed message. Individuals with higher Jackson's BIS scores (as well as higher CC Panic and higher CC FFFS scores) perceived the social loss-framed message to be more effective when it was presented in conjunction with the motor vehicle message than those with lower scores in these measures, respectively. Whereas, no such relationships were observed for those individuals exposed only to the message. Potentially, these BIS/ FFFS findings may be due to stronger BIS and FFFS individuals allocating greater attention towards the negative stimuli, than those lower BIS and FFFS individuals.

For the BAS traits, there was a moderate negative correlation between CC Defensive Fight and attitudes towards the motor vehicle message, which failed to reach significance. While not significant, the direction of the correlation is opposite to what was predicted and may tentatively suggest that CC Defensive Fight is independent of the BAS traits. Whilst CC Defensive Fight was compared to the BAS traits in this research program, Corr and Cooper (2013) developed the Defensive Fight Scale independent of the BAS (and the FFFS) traits. Further, and inconsistent with predictions, the findings also revealed that there was a moderate positive correlation between the CC BAS: Reward Reactivity and message effectiveness, although this correlation also failed to reach significance.

One explanation for the mixed BAS findings may be that participants perceived that driving the vehicle presented in the message was not an achievable goal. For instance, participants may have felt that achieving the goal of driving a high performance vehicle to be unattainable and as such, did not perceive the motor vehicle message to be effective. In turn, the road safety message may be more relevant to the current sample of licensed drivers, either directly (i.e., they themselves speed) or indirectly (i.e., other drivers speed) and thus, might explain why individuals with a stronger FFFS perceived this message to be effective.

Despite the mixed BIS results, the current findings support the theoretical changes to the revised FFFS and BIS. Specifically, individuals with a stronger BIS demonstrated slower processing of the social loss-framed message content, when it was paired with the motor vehicle message. However, there were no similar significant effects observed in the message only condition, nor significant effects of FFFS on processing of the message in the mixed cue condition. Thus, consistent with previous research (e.g., Cooper, Perkins, & Corr, 2007; Perkins, Kemp, & Corr, 2007; White & Depue, 1999), these finding support the view that fear and anxiety are independent emotional systems.

7.6.5 RST, optimism bias, and risky driving behaviour

Overall, participants in the current sample were susceptible to driving related optimism bias (i.e., the belief that others are more susceptible to negative driving outcomes; Weinstein, 1980, see chapter 4). This sample of young drivers perceived themselves to be more skilful, safer, and have greater on-road driving experience, than ‘a typical young driver’. Further, participants also perceived themselves to be less risky and less likely to be involved in a speed related crash than ‘a typical young driver’. These findings are consistent with previous research which has consistently reported that young drivers have the tendency to perceive themselves to be more skilful and have a lower probability of a crash, compared to their same aged counterparts (e.g., Harré et al., 2005; White et al., 2011).

Underestimating the likelihood of negative consequences may have important implications for how young drivers process and accept health communication messages. For instance, if drivers perceive themselves to be more skilful and/or have a lower probability of a crash compared to other drivers, they may be more inclined to ignore the message(s) portrayed in road safety advertisements (i.e., predisposes them to not be influenced). Thus, message designs may need to consider countering optimism bias by, for instance, further highlighting the most relevant risks associated with dangerous driving, particularly for the younger driver population who may be more susceptible to risky driving behaviour.

It was predicted that individuals who are more sensitive to rewards (compared to those who are less sensitive to rewards) would perceive themselves to have greater driving ability and be less susceptible to the negative consequences associated with driving than ‘a typical young driver’. For the significant relationships and inconsistent with expectations, individuals who had stronger BAS traits rated themselves as a relatively riskier driver and perceived themselves to have a greater speed-related crash risk than ‘a typical young driver’, suggesting insight into their own typically riskier behaviour. Further, individuals with stronger CC: Impulsivity traits were also more likely to perceive themselves as less safe than ‘a typical young driver’, indicating that these individuals were aware of their risky driving behaviours. Stronger BAS individuals were also more likely to report greater risky driving behaviour (compared to lower BAS individuals), a finding that were consistent with H.6. As such, these results highlight that even though stronger BAS individuals may be aware of the negative consequences associated with their risky on-road behaviour, they still proceed to engage in risky driving behaviour. Potentially, these findings may reflect stronger BAS individuals’ intention to not only deliberately engage in risky unsafe driving practices but, to also wear this risk as ‘a badge of honour’. These findings further emphasise the need to continue to focus on persuading high risk individuals (such as those more sensitive to rewards) to adopt safer driving behaviours.

As argued throughout, one way to target these higher reward sensitive individuals could be through message design. While the frequently used physical loss-framed messages may be effective at persuading some individuals to adopt safer on-road behaviours (e.g., Goldenbeld et al., 2008), gain-framed/ positive messages may be more effective for those individuals who are particularly sensitive to reward, a group consistently found to be at higher driving risk. Supporting this argument, the current findings revealed that higher scores on CC BAS: Impulsivity and CC BAS: Goal-Drive Persistence were associated with greater effectiveness and attitude ratings, respectively towards the social gain-framed message (no relationships between these traits and message acceptance items were found for the social loss-framed message). Future research should continue to examine how the use of positive/ gain-framed appeals may persuade those who are more sensitive to rewards to take more responsibility on the road, and ultimately reduce their risky driving behaviour.

7.6.6 Gender differences, risky driving behaviour, and perceptual biases

It was further predicted that male drivers would be more susceptible to driving related optimism biases than female drivers. Consistent with predictions (H.8) and previous research (e.g., DeJoy, 1992, Sibley & Harré, 2009), male drivers perceived themselves to be more skilful compared to ‘a typical young driver’ than did female drivers. However, there were no additional significant effects of gender on optimism bias. One reason for these optimism bias findings may be due to the sample consisting of a higher proportion of females than males. While not significant, the trends showed that males had higher mean scores than females on perceiving themselves to more safe and have greater experience compared to ‘a typical young driver’, a finding that is consistent with previous research (e.g., DeJoy, 1992; Harré et al., 2005). However, males and females showed similar mean scores when asked if they perceived themselves to be more risky than ‘a typical young driver’, while females had higher mean scores than males when asked if they perceived themselves to have a greater speed-related crash risk than ‘a typical young driver’, a finding which is inconsistent with the optimism bias literature (e.g., Gosselin et al., 2010).

In the current study, there was no significant difference between genders on self-report speeding behaviour (i.e., 68.6% and 61.2% of males and females reported regularly driving over the posted speed limit, respectively). However, post message exposure findings revealed that male drivers were more likely to report higher on road risk taking behaviour one week after viewing the road safety messages compared to females,[57] suggesting that males may be more susceptible to other on road risks than females (e.g., risks associated with driving too close to the vehicle in front or bending/ ignoring the traffic rules in order to get ahead) or alternatively, that females were more persuaded by the messages. Overall, these findings highlight that all young drivers, not just males may be vulnerable to perceptual biases.

The findings also revealed that male drivers were more likely to perceive that the social loss-framed message was intended for people like them (than for others) compared to female drivers. While this finding was consistent with participants’ discussions in Study 1c, it was not consistent with previous research which has reported that male drivers may be more persuaded by gain-framed messages compared to threat-based messages (e.g., Lewis et al., 2008b). Given that previous research has reported that young males are more likely to report regular speeding behaviour compared to young females (e.g., Horvath et al., 2012a), road safety messages need to be specifically designed to target this high risk group. Designing effective communication messages may not only persuade young male drivers to adopt safer driving behaviour but, may also reduce driver related fatalities that are the result of risk taking behaviour. A potential explanation for the differences in these findings may be due to

[57] The results were approaching significant in self-reported risky driving behaviour between male and female drivers at time 1, with the direction of mean scores indicating that males reported higher risk taking behaviours than female drivers. Differences between the findings may be due to having a higher proportion of males at time 1 (n = 35) than at time 2 (n = 21).

the differences between the message stimuli used (i.e., audio recorded messages vs. text-based messages in Study 2). Further, while previous research has incorporated two items to calculate the TPE (i.e., one item to assess self-perceptions and the other item to assess other's perceptions; e.g., Lewis et al., 2007), Study 2 only contained one item to assess this construct. Thus, discrepancies in findings may be due to the message stimuli or alternatively, the scale used to assess the TPE. While not consistent with previous research these findings, however, highlight how differences in message frame and gender may jointly influence message acceptance.

Inconsistent with previous research which has reported that female drivers may be more persuaded by physical threats than male drivers (e.g., Goldenbeld et al., 2008), the current study found no significant gender differences in the perceived persuasiveness of the physical loss-framed message. Study 1c revealed that male participants were more inclined to spontaneously report that the physical loss-framed message contained message repetition effects than females and likewise report being less persuaded by this message. However, Study 1c consisted of a larger proportion of males than female drivers (i.e., 11 males compared to 6 females), while more females were exposed to the physical loss-framed message in Study 2 than males (i.e., 3 males compared to 24 females). Discrepancies in findings between the two studies may be due to differences in gender or alternatively, different research designs (i.e., smaller qualitative, where participants took part in group discussions vs. larger quantitative design, where participants were required to respond to standard questionnaire items). However, given the unequal proportion of males and females in Studies 1c and 2, conclusions regarding gender differences in the perceived persuasiveness of the physical loss-framed message are unable to be drawn.

While it is acknowledged that some of the current perceptual biases and gender differences findings were inconsistent with previous research (e.g., Goldenbeld et al., 2008;

Lewis et al., 2008b) the current findings contribute to the existing literature by further supporting the need to introduce a range of road safety messages (i.e., gain-framed/ positive and loss-framed/ negative) to target all young drivers. For instance, while some young drivers may be persuaded by gain-framed/positive messages, other drivers may be more persuaded loss-framed/ negative messages. Incorporating a range may increase the persuasiveness of these messages for more people and importantly, reduce risky driving behaviour in the young driver population.

7.6.7 Limitations and Future research

To examine the impact that individual differences in RST traits had on cognitive processing of a range of message stimuli (i.e., gain-framed and loss-framed anti-speeding road safety messages and a motor vehicle message), a LDT task was designed to assess cognitive biases to the words contained in these messages. As previously mentioned, the LDT and word stimuli may not have been sensitive enough in a young adult sample to detect such effects. Future research should incorporate a more sensitive measure of cognitive processing, such as ERPs, and include a broader range of stimuli, such as pictures to further examine the extent to which individual differences in reward and punishment sensitivities may influence the processing of anti-speeding road safety messages.

Alternatively, and as previously noted in section 6.13.1., it could be argued that the lack of significant findings between the BAS and processing of the physical gain-framed message may be due to the message stimuli (i.e., the physical gain-framed message stated that by not speeding, drivers are decreasing their risk of injury and/or crash involvement instead of focusing on the gains associated with increasing a safe behaviour). While Studies 1a and 1c revealed that the physical gain-framed message was functioning as intended, future research that aims to examine the BAS by using road safety messages should also examine gain-framed message(s) that are framed to increase one’s safety oriented behaviour.

Despite the findings from Study 1c that indicated some male drivers perceived the motor vehicle message to contain reward cues (see chapter 6, section 6.12.3), participants' perceptions of the motor vehicle message was not examined independently in Study 2 (i.e., the motor vehicle message was only paired with the social loss-framed message to activate the BIS), to confirm if the motor vehicle message was suitable to activate the BAS in this sample. As such, future research that aims to examine the BIS by using road safety messages and motor vehicle messages, should first assess each stimuli independently to ensure that they are suitable to activate the BAS and FFFS traits, prior to exposing participants to these mixed message cues to examine the BIS.

Consistent with previous research (e.g., Tay & Watson, 2002), the current study relied upon self-report measures of behavioural intentions and message compliance instead of objectively examining participant's driving behaviour. While previous research has reported that behavioural intentions are a reliable predictor of actual behaviour (e.g., Ajzen, 1991), future research could incorporate an objective measure of behaviour, such as a GPS device, to examine actual behaviour and consequently, message compliance. By including such an objective measure of actual driving behaviour, researchers would be able to more objectively assess the extent to which individual differences in RST traits influence actual driving behaviour after exposure to positive/ gain-framed and/ or negative/ loss-framed anti-speeding messages.

The current sample consisted of a larger proportion of female drivers compared to male drivers. Previous research has reported that compared to female drivers, male drivers are more likely to engage in risky driving behaviour (e.g., Harrè et al., 1996; Horvath et al., 2012a) and as such, may be more sensitive to rewards. However, it should be noted that research on gender differences in reward sensitivities are mixed. While some studies have reported that males had higher self-reported BAS scores than females (e.g., Knyazev, Slobodskaya, Kharchenko, & Wilson, 2004), other studies have reported that females had higher self-reported BAS scores compared to males (e.g., BAS: Reward Responsiveness Mardaga & Hansenne, 2007). In this study, for instance, there was a similar percentage of self-reported speeding behaviour in both genders and a reasonable range of variability in the BAS scale scores. However, due to the low proportion of young male drivers in the current sample (despite best efforts to recruit more males), gender differences in message processing and subsequent message acceptance could not be reliably assessed. Future research should include an equal number of female and male participants to examine if gender moderated the current BAS and FFFS findings.

To increase the chance of detecting any significant effects in this research, all significant values were assessed at $p < .05$. However, given that a large number of personality scales were assessed in Study 2, it may be possible that a Type 1 error occurred; a false significant finding. Despite the possibility of a Type 1 error, all significant findings (and approaching significant findings, $p < .10$) had moderate to large effect sizes, suggesting that the current results were not due to chance. However, future studies that examine the influence of RST traits on the relative effectiveness of message framing manipulations may consider using a larger sample and adopting a more sensitive alpha level to reduce the chance of a Type 1 error occurring.

While the current study assessed reward and punishment cues both independently (i.e., gain- and loss-framed message only conditions) and together (i.e., mixed cue condition), the separable and joint subsystem hypotheses were not a focus of this research program and were not examined due to inadequate power. As previously discussed in chapter 2, the separable subsystem hypothesis should predict behaviour when individuals are exposed to only reward or only punishment stimuli, whilst the joint subsystem hypothesis should predict behaviour on presentation of both reward and punishment cues (Corr, 2001, 2002). While the current study was not designed to test the separable and joint subsystem hypotheses, future research should further assess the separable and joint subsystem hypotheses in the context of the revised RST by examining responses to gain-framed/ positive road safety messages and loss-framed/ negative road safety messages both independently (to assess the separable subsystem hypothesis) and together (to examine the joint subsystem hypothesis) in a larger sample.

7.7 Chapter summary

Chapter 7 presented the second study of this research program, which examined the extent to which individual differences, as conceptualised by Gray and McNaughton's revised BAS and FFFS traits, may contribute to young drivers' processing and subsequent acceptance of gain-framed and loss-framed road safety messages. Further, to examine the BIS, a group of young drivers were exposed to two mixed message cues: a social loss-framed message, designed to emphasise the negative consequences of speeding behaviour, and a motor vehicle message that was designed to promote a high performance vehicle. The key findings indicated that while there were some significant relationships between the BAS and FFFS traits and message acceptance in the expected direction with message frame, there were no significant relationships between the RST traits and message processing, except for BIS in the mixed condition. However, the findings revealed that individuals with stronger CC BAS: Impulsivity and CC BAS: Goal-Drive Persistent traits perceived the physical gain-framed message as more effective and reported more favourable attitudes towards the social gain-framed message than those with weaker corresponding BAS traits, respectively. These differences were not observed for the physical loss-framed or social loss-framed message by BAS. Finally, the results suggested that the BIS was activated on presentation of the mixed message cues, as indicated by slower RTs to the words from the social loss-framed message in this condition.

Overall, this study's findings provide some support for creating a range of gain-framed and loss-framed road safety messages that align with different BAS and FFFS types, respectively. While previous research has reported that personality traits are unlikely to change and thus, remain stable (McCrae & Costa, 1994), gain-framed messages that include rewarding/ positive cues may be more persuasive for those stronger reward sensitive individuals than the more traditionally based loss-framed/ threat-based appeals. In the current study, for instance, stronger BAS individuals were more likely to report risky driving behaviours at time 1 and at follow-up (time 2) than those weaker BAS individuals and thus, these findings support the need to implement intervention programs to target these high risk drivers. Conversely, those individuals who are sensitive to punishment cues (i.e., stronger FFFS) may be more persuaded by those loss-framed/ threat-based appeals, however, these drivers are also more likely to be safer on the roads. Considering individual differences in reward and punishment sensitivities when designing road safety appeals may not only increase the persuasiveness of the message but, also may reduce risky driving behaviour among young adults.

Chapter 8. Study 3: Applying RST to Examine the Processing of Still Images from Road Safety Advertisements

8.1 Chapter overview

This chapter presents the final two studies of this research program. A brief introduction on the rationale behind Study 3a and Study 3b is presented first, followed by the studies' research aims and hypotheses. Next, Study 3a, evaluation of picture stimuli, is presented, followed by Study 3b, individual differences in processing of road safety picture stimuli. The chapter concludes by discussing the limitations and future directions of Study 3b.

8.2 Introduction

Study 3 builds upon Study 2 by applying electroencephalography (EEG) to more comprehensively assess message processing, as a function of the Behavioural Approach System (BAS) and the Fight-Flight-Freeze System (FFFS) traits. To further assess the influence of the BAS and the FFFS on processing, Study 3 examined processing towards still positive and negative picture images that were selected from publicly available televised anti-speeding campaigns (devised by the Transport Accident Commission (TAC) in Victoria, Australia). Limited research has applied the revised Reinforcement Sensitivity Theory (RST) in the context of cognitive processing of picture stimuli and, to the best of the author's knowledge, no published research has used Event-Related Potentials (ERPs) to assess message processing in a road safety advertising context. As such, an exploratory approach was undertaken in Study 3.

As discussed in chapter 7, a potential explanation for not finding any significant message processing results in Study 2 may have been due to insufficient salience and sensitivity of the word stimuli and lexical decision task (LDT). Specifically, words included in text-based gain-framed and loss-framed anti-speeding messages may not have carried a sufficiently strong meaning to activate the BAS and the FFFS in this young driver population. For instance, previous research has reported that pictorial stimuli are more effective at persuading individuals to adopt healthier behaviours than text only messages (e.g., Hammond, 2011). Further, visual images are more likely to be portrayed in road safety campaigns than text only messages and, thus may have higher ecological validity. Likewise, the LDT may not have been sensitive enough to assess potential processing biases in this population. For example, younger adults typically demonstrate faster reaction times (RTs) to words in LDTs and as such, faster motor responses could have obscured any potential BAS/ FFFS effects. Study 3 extended upon Study 2 by including picture stimuli and a more sensitive objective measure of processing that does not rely on motor response times, ERPs.

8.2.1 Event-Related potentials

Chapter 5 provided an overview of ERPs, focusing on three components: N100, N200, and P300. These three ERP components have been related to individuals attending to, and processing, emotional picture stimuli in the general population (e.g., Polich & Kok, 1995; Kok, 1997). However, similar to emotional word stimuli, ERPs are sensitive to range of factors that need to be controlled, including arousal (high vs low arousal), valence (negative vs. positive), and repetition of presented stimuli (see Olofsson et al., 2008).

Arousal effects. Differences in emotional arousal can influence ERPs, particularly those occurring after 500ms. For instance, images that are perceived to be higher in arousal produce greater late positive potentials (LPP) than those images rated lower in arousal (Rozenkrants, Olofsson, & Polich, 2008; Rozenkrants & Polich, 2008; Schupp et al., 2004a, 2007; Schupp, Junghöfer, Weike, & Hamm, 2004b), with this arousal effect more evident at the parietal electrode sites (e.g., Dolcos & Cabeza, 2002). Research by Schupp et al. (e.g., 2004a, 2007) has reported that highly arousing positive images (i.e., erotic and romance pictures) lead to more pronounced LPP amplitudes than low arousing positive images (i.e., images of families and sports). Similar findings were also reported by the authors for negative images, whereby highly arousing negative images (i.e., mutilation) lead to larger positive amplitudes than lower arousing images of threat or loss. In Study 3b, three ERPs were included in the analysis (i.e., N100: maximum negative peak between 70-160ms, N200: maximum negative peak between 200-400ms, and P300: maximum positive peak between 300-500ms). Given that all components assessed in Study 3b were under 500ms, arousal should not influence the current ERP findings. However, despite arousal having the greatest effect on ERP components occurring after 500ms, Study 3a incorporated a self-report image rating measure of arousal to further control for any potential arousal effects between the emotional image stimuli (i.e., positive images, negative images, and neutral images).

Valence effects: Negative components. Valence effects for early negative potentials have been mixed. For instance, Keil et al. (2001) reported a more pronounced N100 to emotional negative and positive pictures compared to neutral images, indicating greater attention being paid to the emotional than non-emotional stimuli. In contrast, Palomba, Angrilli, and Mini (1997) reported no significant valence effects 100-200ms after stimulus onset at the central and parietal electrode sites. Moreover, Mardaga and Hansenne (2009) found that positive pictures elicited a smaller N200 response than either the negative or neutral images, suggesting that more attention was allocated towards the negative and neutral images than positive images. However, it has been argued by some (e.g., Luo, Feng, He, Wang, & Luo, 2010) that compared to positive stimuli, negative stimuli may lead to a more pronounced N100 and/ or N200 as aversive/ fearful pictures result in greater early attention than more pleasant/ appetitive stimuli.

Valence effects: Positive components. Similar to the early negative potentials, valence has been reported to influence positive amplitudes, particularly over the frontal neural regions (e.g., Conroy & Polich, 2007). For instance, research has consistently found that larger P300 amplitudes occur on presentation of negative and positive visual stimuli compared to neutral stimuli (e.g., Codispoti, Ferrari, & Bradley, 2006; Cuthbert, Schupp, Bradley, Birbaumer, & Lang, 2000; Dolcos & Cabeza, 2002; Hajeck & Olvet, 2008; Schupp, Junghöfer, Weike, & Hamm, 2004b). However, although some research has found that negative images produce larger amplitudes than positive images between 400-700ms (e.g., Bradley, Hamby, Löw, & Lang, 2007), other studies have reported that positive images produce larger amplitudes than negative images between 400-800ms after picture onset (e.g., Cuthbert et al., 2000; Delplanque, Lavoie, Hot, Silvert, & Sequeira, 2004). In contrast, additional research has reported no significant differences between P300 amplitudes on presentation of positive or negative stimuli (Schupp et al., 2004b).

Bradley et al. (2007), Cuthbert et al. (2000), Delplanque et al. (2004) and Schupp et al. (2004b) recruited young adults from a university population and used images from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1997), however reported mixed findings. Differences in methodologies or gender in their different studies' samples may account for the discrepant findings of amplitudes. Gasbarri et al. (2007), for example, found that the P300 amplitude differed between males and females on presentation of negative images from the IAPS. Specifically, females elicited a more pronounced P300 response in the left hemisphere (P3 and F3 sites), while the P300 response was greater for males in the right hemisphere (P4 and F4 sites). These findings highlight that gender differences may influence neural responses towards emotional stimuli and, thus, that the effect of gender needs to be considered as a potential confound in P300 studies. While every attempt was made to recruit an equal number of male and female participants in Study 3b few males volunteered, resulting in the majority of the sample being female (69%). As such, female participants only were in the main analysis to avoid any potential gender confounds.

To control for valence effects in the current program of research, participants were required to rate the valence of each image in Study 3a, with the images that were rated the most positive, the most negative, and the most neutral retained for use in Study 3b. Further, given that amplitude differences may influence valence effects (positive vs. negative vs. neutral stimuli), valence was assessed independent of personality in Study 3b prior to examining the RST trait and ERP effects. By controlling for potential valence confounds, findings from Study 3b can be interpreted as reflecting differences in the BAS and the FFFS and not differences in positive, negative, and neutral stimuli.

Repetition effects. Repetition of visual images has been reported to influence the latency and amplitude of ERPs (Codispoti et al., 2006, 2007; Olofsson & Polich, 2007; Rozenkrants et al., 2008). For instance, Olofsson and Polich (2007) found that although picture repetition decreased ERP latency, repetition of picture images increased P300 amplitude. Similar amplitude findings were reported by Codispoti and colleagues, when they presented emotional picture images up to 60 and 90 times each in their 2006 and 2007 studies, respectively. To avoid repetition effects in Study 3b, each picture image was presented only once to the participants using the oddball paradigm.

8.2.2 Oddball paradigm

The computerised oddball paradigm was included in Study 3b as it is commonly used to measure ERPs, particularly the P300 component (Kok, 1997) and has been applied successfully in previous research to elicit the P300 response (e.g., Cano et al., 2009; De Pascalis et al., 2004; Delplanque et al., 2004; Rozenkrants & Polich, 2008). In the oddball task, participants are exposed to two stimuli: one standard stimulus, presented approximately 80 percent of the time, and rare target stimuli (i.e., oddball stimuli) presented approximately 20 percent of the time. On presentation of the infrequent stimulus, participants elicit a P300 response (Pritchard, 1981). In Study 3b, a modified visual oddball task was designed to assess individual differences towards the processing of positive and negative picture stimuli (see section 8.6.3.1).

8.2.3 Reinforcement Sensitivity Theory

Previous ERP research in the RST field has typically used word stimuli. More recently, however, and during the course of this PhD research program, research has begun to emerge on assessing the effects of the BAS and the FFFS on processing of positive and negative emotional visual stimuli (i.e., Balconi et al., 2012; Gable & Harmon-Jones, 2013). Gable and Harmon-Jones (2013) reported that stronger BAS individuals elicit larger N100 mean amplitude responses towards positive images than weaker BAS individuals. However, and inconsistent with the theoretical predictions of the RST, Gable and Harmon-Jones (2013) reported no significant relationships between Gray's original RST traits and the P300 response on presentation of positive and negative stimuli. Balconi et al. (2012), however, found that individuals who reported stronger BAS and original Behavioural Inhibition System (BIS) traits elicit larger P300 mean amplitude responses towards positive and negative images, than those with weaker BAS and original BIS traits, respectively. These findings highlight inconsistencies within the RST and ERP research using visual image stimuli and support the need for research to further evaluate the potential RST effects on pre-attentional and cognitive processing of image stimuli.

Study 3 extends on these studies by examining ERP responses to images from road safety campaigns. Specifically, while pictures of desserts and images from the International Affective Picture System (IAPS) were used to assess RST traits in Gable and Harmon-Jones (2013) and Balconi et al. (2012), the current study contained picture images that had been taken from previously aired road safety advertisements. Thus, Study 3 contributed to the literature by assessing if individual differences in BAS and FFFS traits influenced pre-attentional processes (as assessed by early negative potentials; N100 and N200) and cognitive processing (as assessed by a LPP: P300) of positive and negative picture stimuli taken from road safety advertisements.

8.2.4 Health communication research

In the health communication field, limited research has used ERPs to assess message processing. As discussed in chapter 5, previous research which has applied ERPs to assess attention and processing of health communication messages has reported that individuals are more likely to attend to tailored than to non-tailored nutrition education messages (Kessels et al., 2011; Ruiter et al., 2006) and to high-threat compared to low-threat anti-smoking messages (Kessels et al., 2010). Further, Kessels et al. (2011) found that despite individuals demonstrating greater attention towards the tailored nutrition education messages (as assessed by the P300 response), participant self-report ratings revealed that participants perceived no differences in their attention towards the tailored compared to non-tailored messages. As such, these findings highlight the benefits that ERP measures may have in tapping processes outside an individual's consciousness to further understand both attention and processing of health communication messages.

The current study was designed to add to the current literature by using ERPs to evaluate attention and cognitive processing of road safety message content. Incorporating ERPs to assess road safety advertisement processing may increase understanding of the neurological processes underlying message processing and may, ultimately, contribute to the design of more effective messages to target high risk road users, such as young drivers. Study 3b explored the method of assessing road safety advertising processing via ERPs by exposing young drivers to a range of emotional positive and negative still advertisement images.

Given that the purpose of Study 3b was to explore the potential effects of the BAS and the FFFS traits on pre-attentional processes and higher-order cognitive processing of general positive and negative valenced emotion-based images, specific discrete emotions were not examined here. Interested readers should refer to previous research that has reviewed specific discrete positive (e.g., pride and humour) and negative (e.g., fear) emotions in relation to road safety advertising (see Lewis et al., 2007, 2008a, 2010).

8.3 Aim and Hypotheses

8.3.1 Study 3a

The aim of Study 3a was to assess if the positive and negative picture stimuli would be suitable to activate the BAS and the FFFS traits in Study 3b. No hypotheses were generated for Study 3a, rather the Study was intended as a stimuli check in terms of examining the perceived valence and arousal of the picture stimuli.

8.3.2 Study 3b

Study 3b was an exploratory study that examined if individual differences in BAS and FFFS traits influenced individuals' processing of positive and negative still images (used in previous anti-speeding campaigns). For the purpose of Study 3b, picture processing biases were measured via three ERP components: N100, N200, and P300.

H.1a. It was predicted that individuals with stronger BAS traits would elicit larger N100 and N200 mean amplitudes (i.e., demonstrate greater pre-attentive processing) towards the positive images (compared to those with weaker BAS traits).

H.1b. It was predicted that individuals with stronger FFFS traits would elicit larger N100 and N200 mean amplitudes on presentation of the negative images (i.e., demonstrating greater pre-attention towards these images) than those individuals with weaker FFFS traits.

H.2a. It was predicted that individuals with a stronger BAS would show greater processing biases towards positive pictures (as shown by larger P300 mean amplitudes) than individuals with a weaker BAS.

H.2b. It was predicted that individuals with a stronger FFFS would elicit larger P300 mean amplitudes on presentation of the negative images than those individuals with a weaker FFFS.

Study 3a: Evaluation of Picture Stimuli

8.4 Method

8.4.1 Participants

Young drivers (*N* = 27, 19 females) were recruited via the QUT on-line participant recruitment system to complete the self-report questionnaire. Participants (*Mage* = 19.71, *SD* = 2.41) were all required to have a valid Australian drivers licence (7 held an open unrestricted licence and 20 held a provisional restricted licence). Twenty-four participants reported English as their first language. All participants received partial course credit of 1 hour for completing the questionnaire.

8.4.2 Materials

Picture stimuli. The initial selection of picture stimuli comprised 65 images shown in previously aired road safety campaigns and 45 royalty free neutral images sourced from the internet (see Appendix N for example picture images). The majority of pictures included here comprised of social images, because there was a very limited number of physical images that could be sourced from previous *positive* emotion-based road safety campaigns.[58] All picture images were scaled to 800 x 600 resolution (image size: 7 x 7cms) and contained no overlaid writing. Given that the aim of this research was to examine the influence that individual differences may have on processing road safety images,[59] no further changes were made to these road safety images (e.g., matching the brightness of negative and positive images).

While it is acknowledged that 30-60 stimuli per valence condition is considered ideal to compute the P300 grand averages (Luck, 2005), there were only a limited number of positive emotion-based advertisements from which to select the positive picture stimuli (i.e.,

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[58] In Studies 3a and 3b, social images consisted of images of individuals and families; physical images comprised of images of vehicles.

[59] Pictures were chosen from previous TAC televised campaigns (as opposed to campaigns previously aired in Queensland, where the sample were recruited) to limit the potential that participants had previously viewed these road safety advertisements.

five positive advertisements vs. 16 negative advertisements). Further, the images were only selected from congruent contexts (i.e., positive images were taken from positive campaigns and negative images were taken from negative campaigns) to control for potential confounds had participants been previously exposed to these TAC advertisements via the internet or an alternative media source. Despite the reduced number of picture stimuli (24 images per a condition), previous research has reported that as few as 20 images per condition is suitable to calculate an averaged P300 response (Cohen & Polich, 1997) and various published studies that have assessed emotional picture processing as a function of personality have calculated average ERPs using between 20-30 stimuli per valence condition (e.g., Li et al., 2005; Mardaga & Hansenne, 2009).

8.4.3 Procedure

Participants were randomly assigned to complete one of two online versions of the questionnaire (i.e., two versions were designed to counterbalance the order of the picture stimuli and thus, minimise the influence of order and/ or fatigue effects). First, participants were asked to provide demographic information (e.g., age and gender), followed by a series of 7-point semantic differential scales used to rate the valence (1 = *negative*, 7 = *positive*) and arousal (1 = *low arousal*, 7 = *high arousal*) of each of the 110 picture stimuli (i.e., 65 road safety images from a total of 21 advertisements[60] and 45 royalty free neutral images).

8.5 Results and Discussion

Paired *t*-test analyses examined if the picture stimuli were perceived as intended (e.g., the positive pictures were rated as more positive and the negative images were rated as more negative). Of the 110 pictures included in the questionnaire, and based on the participants' ratings, the 72 most positive, most negative, and most neutral images (i.e., 24 images for each picture condition) were selected for use in the analyses reported here. The valence and

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[60] 32 positive images and 33 negative images.

arousal results and discussion are presented first, followed by a series of independent groups *t*-tests which were used to examine gender differences in these valence and arousal ratings.

8.5.1 Valence ratings

A repeated-measures ANOVA was used to assess differences in mean valence ratings between the picture stimuli. There were significant difference in perceived valence between the positive (M = 5.56, SD = 0.59), negative (M = 2.19, SD = 0.39), and neural images (M = 3.91, SD = 0.41), $F(2, 50) = 315.08$, $p < .001$. Pairwise comparisons indicated that the positive images were rated more positive and the negative images were rated more negative, $p < .001$, 95% CI [3.03, 3.73], as anticipated. Further, consistent with expectations, the positive images were rated more positive than the neutral images, $p < .001$, 95% CI [1.39, 1.92], while the negative images were rated more negative than the neutral images, $p < .001$, 95% CI [-1.92, -1.53].

Study 3a findings suggested that the three picture groups significantly differed in valence in the intended directions and, as such, the 24 positive pictures were considered appropriate stimuli to activate the BAS while the 24 negative pictures were considered appropriate to activate FFFS in Study 3b. The 24 neutral images were included as a control measure.

8.5.2 Arousal ratings

A repeated-measures ANOVA revealed that there were significant differences in mean arousal ratings between the positive (M = 2.77, SD = 1.30), negative (M = 3.36, SD = 1.37), and neutral images (M = 2.28, SD = 0.98), $F(2, 52) = 10.03$, $p < .001$. Pairwise comparisons revealed that while similar small arousal ratings were obtained for the positive and negative picture stimuli, $p = .073$, 95% CI [-1.23, 0.58], participants perceived the positive images to be slightly more arousing than the neutral images, $p = .001$, 95% CI [0.21, 0.76]. Similarly, the negative images were also perceived to be more arousing than the neutral images, $p < .001$, 95% CI [0.58, 1.56]. It is also worthwhile noting, however, that all arousal ratings were considered to be low (i.e., mean ratings < 4, using a 7-point semantic differential scale).

8.5.3 Gender differences in valence and arousal ratings

Independent groups *t*-tests revealed that there were no significant differences in mean valence ratings between the female and male participants (see Table 8.1). However, significant gender differences in mean arousal ratings were reported, in which female participants reported slightly higher arousal in response to the negative images than males (see Table 8.1). Once again, the mean arousal ratings from the female participants were considered to be low (i.e., < 4).

Previous research has reported that arousal may influence the LPP response (e.g., Schupp et al., 2007). Specifically, stimuli that are perceived as highly arousing have been reported to increase the LPP amplitude compared to those that are rated lower in arousal (e.g., Cuthbert et al., 2000; Palomba, Sarlo, Angrilli, Mini, & Stegagno, 2000; Schupp et al., 2007), with this effect more evident in later positive ERP components occurring 500ms after onset (e.g., Rozenkrants et al., 2008). However, in Study 3b the P300 was defined as the mean amplitude that occurred between 300-500ms after stimulus onset and, thus ERPs occurring 500ms after onset were not assessed in the subsequent study. Therefore, it was considered that slight differences in perceived arousal between the stimuli would be unlikely to confound Study 3b's findings.

In summary, the findings from Study 3a suggest that the emotive quality of the positive and negative images were appropriate to include in Study 3b to active the BAS and FFFS traits. The next section of this chapter presents the ERP research component. Study 3b examined if individual differences in Gray and McNaughton's BAS and FFFS traits influence

ERP measured processing of the emotional still images used in previous positive and negative road safety anti-speeding messages.

Table 8.1

Mean Valence and Arousal Ratings of Picture Stimuli, by Gender

Picture images	*n*	*M (SD)*	*t*	*p*	95% CI	η^2
Valence ratings						
Negative pictures						
Male	8	2.21 (0.43)				
Female	19	2.13 (0.41)	0.46	.652	-0.28, 0.44	.01
Positive pictures						
Male	8	5.59 (0.63)				
Female	18	5.55 (0.59)	0.13	.898	-0.49, 0.56	.00
Neutral pictures						
Male	8	3.77 (0.29)				
Female	19	3.98 (0.44)	-1.25	.224	-0.56, 0.14	.11
Arousal ratings						
Negative pictures						
Male	8	2.33 (0.88)				
Female	19	3.79 (1.31)	-2.88	.008	-2.52, -0.42	.30
Positive pictures						
Male	8	2.79 (1.67)				
Female	19	2.76 (1.17)	0.05	.959	-1.12, 1.18	.00
Neutral pictures						
Male	8	2.04 (0.99)				
Female	19	2.39 (0.98)	-0.83	.416	-1.20, 0.51	.07

Note. CI = Confidence Interval

Study 3b: Individual Differences in Processing Road Safety Picture Stimuli

8.6 Method

8.6.1 Participants

Thirty-five young drivers were recruited via email and online advertising. While every attempt was made to recruit an equal number of male and female participants, few males volunteered and therefore the majority of the sample were female (*n* = 24, 69%). As recommended by Picton et al. (2000), EEG studies should include an equal number of males or females or include only males or females to control for gender effects. Given that Study 2 contained a majority of female participants and direct comparisons are made between Studies 2 and 3b in chapter 9, only females were included in the main data analysis.[61] Of those female participants, five were excluded from further analysis due to excessive noise in their EEG recordings (i.e., artifacts > 50% in the EEG signal and/ or having < 20 free artifact free trials per each valence condition). A further three participants were excluded as their impedance was greater than 5 kΩ due to thick hair, leaving a final sample of 16 participants (*Mage* = 19.56, *SD* = 2.39).

All participants reported holding a current provisional or open Australian driver's licence (three (18.8%) held an open licence, nine (56.2%) held a provisional 1 restricted driver's licence, and four (25%) held a provisional 2 restricted driver's licence) and on average, received their learner's licence at 16.75 years (*SD* = *0*.68). Participants reported driving an average of five hours each week (*SD* = 3.75). Ten (65.5%) participants reported regularly driving 1-10km/hr over the posted speed limit, while the remaining six (37.5%) participants reported regularly driving at/ below the posted speed limit.

Of the 16 participants, 14 (87.5%) identified with a Caucasian/ European background and one participant each identified with a Caucasian/ Asian background and a Middle Eastern

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[61] For any readers interested in the male (*n* = 9) ERP findings, the results are presented in Appendix O.

background. For education, 11 participants (68.8%) reported a secondary high school certificate as their highest level of education, three (18.8%) participants had completed a Certificate III-IV, diploma, or advanced diploma, while the remaining two (12.5%) participants had completed a university undergraduate degree. The majority of participants (*n* = 15; 93.8%) were enrolled in a current full-time university degree and one (6.2%) participant was enrolled as a part-time university student. Eight (50%) participants reported casual employment, three (18.8%) participants were employed part-time, while the remaining five (31.2%) were unemployed.

To control for possible confounds with tracking neural activity, selection criteria advertised to participants included being right handed, speaking English as their first language, and having normal/ corrected to normal vision (self-reported by the participants). Exclusion criteria (by self-report) consisted of any diagnosed psychiatric or neurological disorders, use of medication that may influence the EEG recordings (i.e., antiepileptic, antidepressant or anti-anxiety medications) and illicit drug use. While most participants (*n* = 15; 93.8%) reported low/ moderate daily intake of caffeine, one participant reported drinking a high amount of caffeine (i.e., more than 3 espresso cups or 5 cups of instant coffee or any drink that contains a high amount of caffeine per day). However, participants were advised to minimise nicotine and caffeine intake the morning of participating in the study. All participants reported drinking less than or one standard drink of alcohol per day. Two participants received a AUD$20 shopping gift card for their participation, while the remainder who were enrolled in an introductory psychology subject received partial course credit (3% towards their final grade).

8.6.2 Design and Analysis Plan

A within-groups design was employed in which individuals were exposed to all picture images (i.e., negative, positive, and neutral images). For the behavioural RT data, bivariate correlation analyses was first conducted to explore the influence that individual differences in BAS and FFFS traits had upon relative RTs to the picture images. Given that previous research has reported that positive and negative images elicited larger mean amplitudes than neutral images (see Olofsson et al., 2008), a series of 3 (picture valence category: negative, positive, neutral) x 4 (electrode site: Fz, Cz, Pz, Oz) repeated-measures ANOVAs were first undertaken to assess picture processing (measured via three mean amplitudes: N100, N200, and P300). Tests of simple effects were used to follow-up all significant valence x electrode interactions.

Next, using the mean amplitude difference scores,[62] a series of one-way repeated-measures ANOVAs were undertaken to test the potential effects of the individual RST traits on picture processing, as a function of valence category. For these ANOVAs, Valence was entered as the repeated measures IV, the BAS and the FFFS traits were each entered in separate analyses as the continuous CVs, and the ERPs (i.e., mean amplitudes at the N100, N200, and P300) were entered separately as the DV. Significant trait main effects and trait x valence interactions were interpreted by follow-up simple linear regressions (see DeCoster, 2004). To maximise the probability of identifying a significant effect in these RST analyses, the significance value was assessed at $p < .05$. Consistent with Study 2 analyses, partial eta squared is reported herein as the measure of effect size for all repeated-measures ANOVAs.

8.6.3 Materials and Procedure

Participants completed the experiment in an EEG laboratory between 9am-4pm. Participants first completed the self-report questionnaire prior to having the EEG cap fitted for the computerised oddball task. The questionnaire consisted of questions that related to demographics (e.g., age and gender), driving history (e.g., type of drivers' license) and current speeding behaviour. Three self-report scales were included to assess RST traits (i.e.,

[62] Checkerboard mean amplitudes subtracted from the image mean amplitude.

20 item Carver and White's BIS/ BAS Scales, 30 item Jackson-5 Scales and 79 item Corr-Cooper RST-PQ).[63] After completing the self-report questionnaire and having the EEG cap fitted, participants were positioned 150cm in front of the computer screen (6.2″ screen size; 800 x 600 screen resolution) to complete the computerised visual oddball paradigm task.

8.6.3.1 Computerised visual oddball paradigm task. The visual oddball task consisted of 3 blocks x 100 trials. Each block included 76 'standard', black and white checkerboard images and 24 'rare', picture images. A total of 72 images were included across the three blocks and since picture repetition effects have been reported to reduce the P300 mean amplitude (e.g., Codispoti et al., 2006, 2007), each image was only presented once. A trial consisted of an image presented in the centre of the screen for 2000ms, following a 500ms fixation cross. The image was followed by a blank white screen that appeared for 2500ms before the fixation cross was again presented (see Figure 8.1).

Participants were instructed to direct their attention towards the fixation cross. They were asked to respond as fast and as accurately as possible as to whether the image that followed was a picture (by pressing 1 with their index finger on the computer keypad) or a checkerboard image (by pressing 2 with their middle finger on the computer keypad). Participants were also requested to minimise head and jaw movement throughout the oddball task. Participants first completed a short practice block that contained three picture images and six checkerboard images, prior to completing the three main oddball blocks. A mandatory rest break of one minute was provided between each block, however, participants could choose to extend this rest break if required (i.e., by pressing the 'Enter' key on the computer keypad when ready to start the next block after the short rest period). Block order was counterbalanced between participants to reduce any potential order and/ or fatigue effects

[63] See chapter 7, section 7.4.3.2, for a detailed overview of the self-report personality measures.

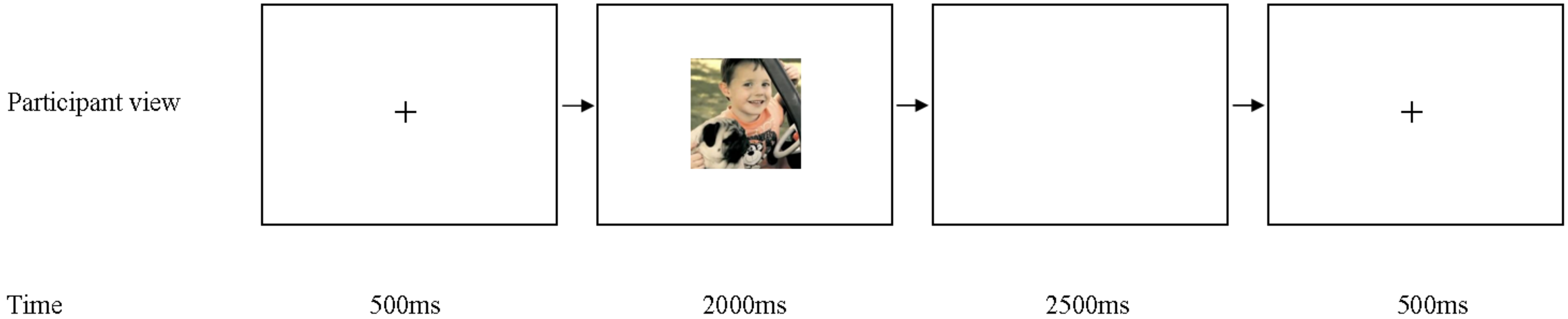

Figure 8.1. An example of an Oddball trial. Picture and checkerboard stimuli were presented to participants on a white background. The picture presented in this figure was one of the positive images included in the experimental task.

(i.e., one-third of the participants were exposed to block 1 first, one-third to block 2, and one-third to block 3).

8.6.4 EEG recordings

A 32 channel head cap recorded neural activity with BioSemi Active Two system software (see http://www.biosemi.com/). Electrodes were placed using the international 10-20 system (Jesper, 1958), with the Cz electrode used as the online reference (later re-referenced offline to the average of all 32 electrodes). Continuous EEG recording was set at a digitised online sampling rate of 512Hz with band-pass of amplifiers filtered between 0.1 and 100Hz. Impedance was 5 kΩ or less for each electrode site. Vertical and horizontal electrooculograms (EOGs) were recorded at three electrode sites: right of right eye, left of left eye, and below the left eye.

8.6.5 Data reduction

Brain Electrical Source Analysis (BESA 6.0; MEGIS Software GmbH, Gräfelfing, Germany, www.besa.de/) was used for initial filtering and analysis of the EEG recordings. Each individual participant file was visually inspected for muscle movement, prior to rejecting all eye artifacts between -100 to 200ms. BESA software was then applied to reject any remaining artifacts that had voltages above 150uV. A cut-off of 0.1 Hz lowpass, 6dB/oct, forward digital filter was used to assess the EEG data with the notch filter set at 50Hz. Further, a cut of 45Hz, 24 dB/oct, zero phase digital filter was applied prior to creating the grand averages. Epochs of -300ms to 1000ms were created from the continuous recordings, with the average of 100ms prior to stimulus used as the baseline. Average artifact free trials per participant were 22 for each of the negative, positive, and neutral stimuli.

8.6.6 ERP waveforms

Using the average artifact free trials, grand average waveforms were calculated in BESA for each picture condition (i.e., negative stimuli, positive stimuli, and neutral stimuli;

see Figures 8.2 and 8.3 for the total grand average waveforms and topographical maps, respectively, with the individual participant grand average waveforms presented in Appendix P). On visual inspection of the grand average waveform, three ERPs were identified for further data analysis (i.e., N100: maximum negative peak between 70-160ms, N200: maximum negative peak between 200-400ms, and P300: maximum positive peak between 300-500ms).[64]

As discussed in chapter 5, previous research has reported that the P300 is more pronounced over the anterior-posterior midline and increases in amplitude from the frontal to parietal neural regions (Duncan et al, 2009; Johnson, 1993). Therefore, mean amplitude data from four corresponding electrode sites (i.e., Fz, Cz, Pz, and Oz) were used in the analyses that follows. Consistent with previous RST-ERP research (e.g., Skatova & Fergusson, 2013), difference scores (i.e., checkerboard mean amplitude minus picture mean amplitude) were calculated to examine the effects of BAS and FFFS on picture processing; the mean amplitudes for each participant included in the following ERP analyses were computed as the difference between the valence stimuli and the checkerboard stimuli mean amplitudes.

[64] P100 and P200 were also evident at the Oz electrode site, only. However, the focus of this research was to assess pre-attentional processes and cognitive processing via the N100, N200, and P300. As such, it was beyond the scope of this study to assess early to middle positive potentials.

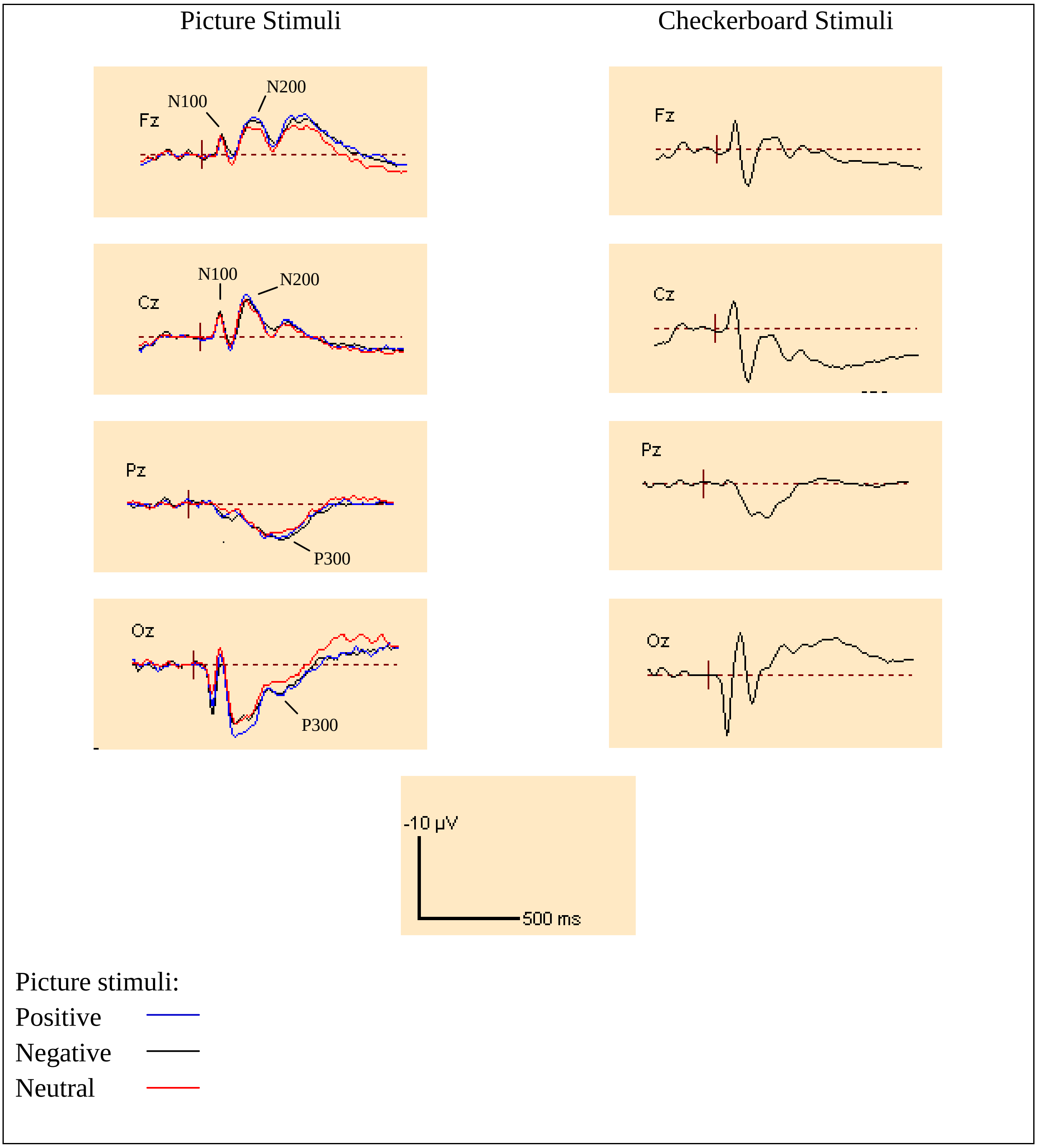

Figure 8.2. Grand average ERP waveforms elicited by the picture and the checkerboard image stimuli. Electrodes are presented along the anterior-posterior midline, as they were located on the scalp. Stimulus onset occurred at 0ms, with the baseline measurement occurring 100ms prior to onset.

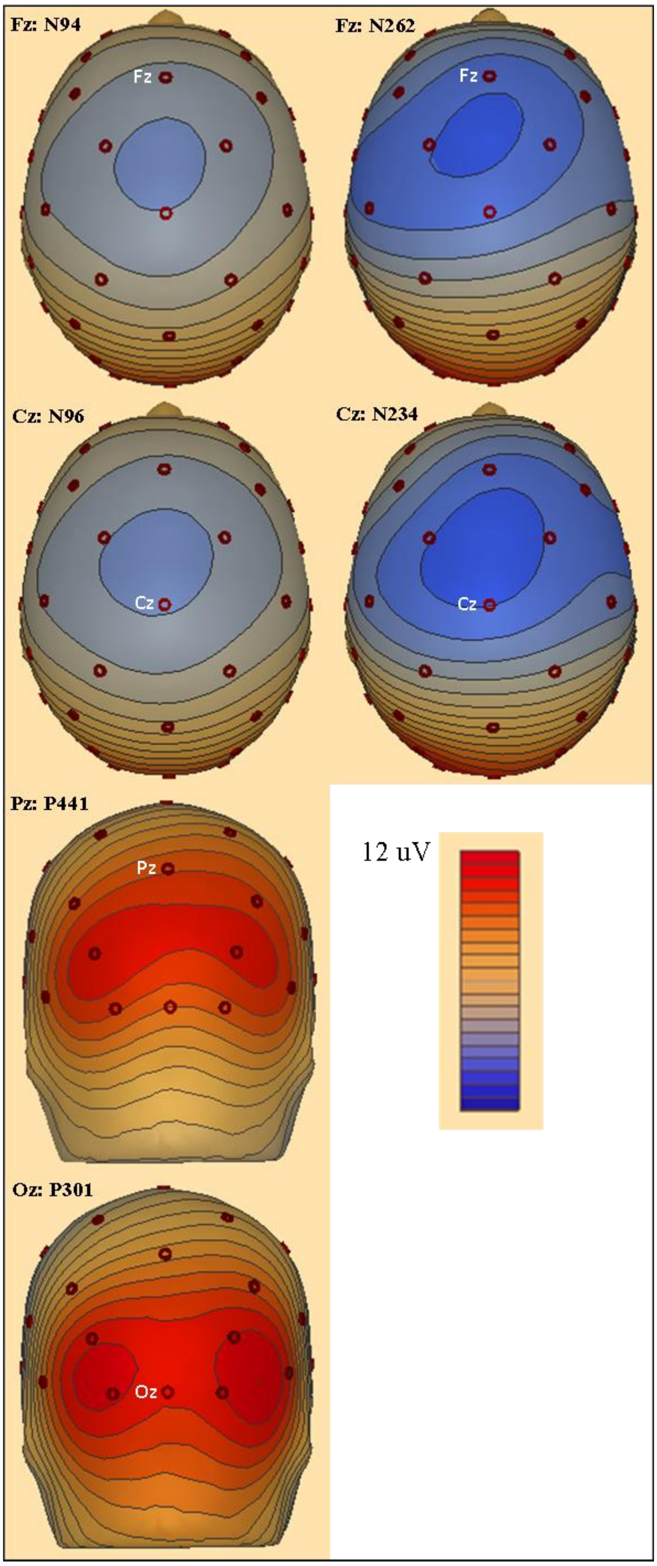

Figure 8.3. Topographical maps illustrating the peak scalp voltages for each electrode site (i.e., Fz, Cz, Pz, and Oz) after picture onset. Red colouring represent positive voltages and blue colouring represent negative voltages.

8.7 Results

The results of Study 3b are organised into four sections. Section one presents the data cleaning, reliability and assumption checks, followed by the preliminary inter correlations of the RST scales presented in section two. Next, the behavioural RT and psychophysiological data are presented.

8.7.1 Data cleaning

Missing data. Visual inspection revealed that only two individual item scores were missing on the RST scales only.

Reliability. Cronbach's alpha was used to assess the reliability for each of the RST scales (see Table 8.2 for the reliability and descriptive statistics). The table shows that the scale reliabilities of CW BIS: Anxiety, CC Panic, Jackson's Fight, Jackson's Freezing, and Jackson's FFFS were less then desirable (i.e., $\alpha < .70$). All remaining scales showed acceptable internal consistency (i.e., $\alpha \geq .70$, Cronbach, 1951; however, CC BAS: Impulsivity and Jackson's BAS scales were slightly under .70). Given that all of the same scales had previously shown acceptable reliabilities in Study 2 (see chapter 7, section 7.4.3.2), it was suspected that the smaller sample size may have influenced the scale reliabilities (Ponterotto & Ruckeschel, 2007).

To improve the reliability of the CW BIS: Anxiety scale in the current study, one item (i.e., "I feel worried when I think I have done poorly at something") was removed to achieve a higher alpha ($\alpha = .52$). Further, the scale item, "If a burglar broke into my house, I would immediately look for a weapon", was removed from Jackson's FFFS scale to enhance scale reliability ($\alpha = .58$). These two revised scales were included in further analyses as measures of BIS and FFFS, respectively, however it is acknowledged that CW BIS: Anxiety and Jackson's FFFS scale reliabilities were still less than ideal. Further, since the removal of items from CC Panic scale, Jackson's Fight scale, and Jackson's Freezing was not a means to

Table 8.2

RST Scale Reliability (Cronbach's Alpha) and Descriptive Statistics for the RST scales (N = 16)

RST Scales	Cronbach's Alpha	*M* (*SD*)
Carver and White BIS/ BAS Scales:		
BAS: Reward Responsiveness	.79	3.43 (0.46)
BAS: Drive	.89	2.58 (0.65)
BAS: Fun Seeking	.73	2.84 (0.56)
BIS	.73	2.91 (0.41)
BIS: Anxiety	.33	3.00 (0.39)
FFFS: Fear	.74	2.79 (0.51)
Corr and Cooper's RST-PQ:		
BAS: Reward Interest	.83	2.74 (0.62)
BAS: Goal-Drive Persistence	.92	3.13 (0.64)
BAS: Reward Reactivity	.88	2.87 (0.61)
BAS: Impulsivity	.67	2.45 (0.53)
FFFS	.75	2.21 (0.53)
BIS	.90	2.31 (0.51)
Panic	.62	1.93 (0.50)
Defensive Fight	.75	2.59 (0.53)
Jackson-5 Scales:		
BAS	.67	3.74 (0.60)
BIS	.79	3.75 (0.64)
FFFS	.48	2.76 (0.36)
Flight	.70	2.57 (0.77)
Fight	.40	2.58 (0.49)
Freezing	.59	3.13 (0.69)

improve reliability, no changes were made to the CC Panic and Jackson's Freezing scales. The Jackson's Fight scale, however, was removed from further data analyses given its low reliability.

Assumption checks and outliers. Normality was assessed both visually (i.e., via histograms, Q-Q plots, and P-P plots) and statistically (i.e., via skewness and kurtosis statistics), while univariate outliers were assessed via histograms, stem and leaf plots, and box plots. All RST scales, with the exception of CW BIS: Anxiety and CC Defensive Fight were normally distributed. For CW BIS: Anxiety, the skewness and kurtosis statistics were -1.42 and 2.68, respectively. However, this breach in normality was due to one outlier that was greater than 2 standard deviations above the mean and its removal normalised the CW BIS: Anxiety scale. For the CC Defensive Fight scale, the kurtosis statistic was -1.27. However, Cameron (2004) states that kurtosis values between +/- 2 are acceptable and consequently, no changes were made to the CC Defensive Fight scale. No additional outliers were identified for the RST scales.

For the RT to image data, normality was breached in all three experimental conditions: RT to the negative images (skewness statistic, 1.91; kurtosis statistic, 5.28), RT to the positive images (skewness statistic, 1.67; kurtosis statistic, 4.15), and RT to the neutral images (skewness statistic, 2.04; kurtosis statistic, 5.32), all demonstrating a leptokurtic distribution. However, these breaches were due to one extreme outlier (i.e., > 3 *SD* above mean) and once removed, the RT data was normalised. Similarly, one extreme outlier (i.e., > 3 *SD* above mean) was removed from the positive valence N200 and P300 mean amplitude data at each of the four electrode sites: Fz, Cz, Pz, and Oz.

8.7.2 Preliminary correlations

For the most part, there were significant moderate to strong positive relationships between the different BAS scales, between the different FFFS scales, and between the BIS scales, as expected (see Tables 8.3 and 8.4 for the BAS traits and FFFS/ BIS traits, respectively). However, while not significant, the direction of the relationships between CC BAS: Goal-Drive Persistence and three other self-report BAS scales: CW BAS: Fun Seeking, CC BAS: Impulsivity, and CC Defensive Fight were negative instead of the positive relationship which was expected. For the BIS scales, there was no significant relationship between the CC BIS scale and Jackson’s BIS scale, even though conceptually, the two scales are proposed to measure the same construct (i.e., behavioural inhibition). This finding is inconsistent with the results from Study 2, which found a moderate significant positive relationship between the two BIS scales. As such, discrepancies in findings may reflect the

Table 8.3

Bivariate Correlations between Self-report BAS Traits

	1	2	3	4	5	6	7	8	9
1. CW BAS: Reward Responsiveness	-								
2. CW BAS: Drive	.549*	-							
3. CW BAS: Fun Seeking	.235	.181	-						
4. CC BAS: Reward Interest	.637**	.166	.539*	-					
5. CC BAS: Goal-Drive Persistence	.709**	.498*	-.208	.377	-				
6. CC BAS: Reward Reactivity	.745**	.457	.236	.444	.421	-			
7. CC BAS: Impulsivity	.244	.132	.596*	.519*	-.267	.284	-		
8. CC Defensive Fight	.173	.230	.400	.197	-.216	.274	.451	-	
9. J5 BAS	.564*	.419	.754**	.687**	.337	.357	.414	.212	-

Note. CW = Carver and White BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales
** $p < .01$
* $p < .05$

Table 8.4

Bivariate Correlations between Self-report BIS/ FFFS Traits

	1	2	3	4	5	6	7	8	9	10
1. CW BIS	-									
2. CW BIS: Anxiety	.792**	-								
3. CW FFFS: Fear	.921**	.499	-							
4. CC BIS	.612*	.713**	.530*	-						
5. CC FFFS	.448	.389	.420	.603*	-					
6. CC Panic	.549*	.436	.597*	.673**	.673**	-				
7. J5 BIS	.554*	.306	.516*	-.077	-.077	-.112	-			
8. J5 Flight	.366	.336	.302	.546*	.546*	.158	.095	-		
9. J5 Freezing	.297	.619*	.183	.738**	.738**	.681**	-.226	.333	-	
10. J5 FFFS	.312	.445	.279	.707**	.707**	.438	-.011	.850**	.662**	-

Note. CW = Carver and White BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales. CW BIS includes all of the CW BIS: Anxiety and CW FFFS: Fear items. J5 FFFS includes all of the J5 Flight and J5 Freezing items.
** $p < .01$
* $p < .05$

smaller sample size of 16 in Study 3 and associated variability in responses (compared to a larger sample size of 133 in Study 2). Given that the focus of Study 3b was on the BAS and FFFS constructs, the absence of a significant relationship between the CC BIS and Jackson's scales should not have an effect on this study's findings.

8.7.3 Behavioural data[65]

Baseline reaction time data. A repeated-measures ANOVA revealed that there was no significant differences between participants' mean RTs towards the negative (*M* = 500.04ms, *SD* = 63.58), positive (*M* = 501.29ms, *SD* = 71.33), or neutral (*M* = 492.95ms, *SD* = 59.73) picture stimuli, $F(2,28) = 1.25$, $p = .304$. These findings are consistent with previous research that have applied the visual oddball paradigm and reported no significant mean RT differences between negative, positive, and neutral picture categories (e.g., Mardaga & Hansenne, 2009). The mean percentage of correct responses for the picture stimuli was 98% for each picture condition, and thus the same accuracy levels were reported for all valence conditions. Consistent with previous research (e.g., Russo, De Pascalis, Varriale, & Barratt, 2008), there was a significant difference between the picture and checkerboard mean RTs (*M* = 426.78ms, *SD* = 73.10), $F(1.92, 26.91) = 50.06$, $p < .001$, [66] indicating that participants were quicker to respond to the frequent stimuli (i.e., checkerboards) than the non-frequent stimuli (i.e., picture images).

RST and relative reaction time data. To control for individual differences in motor speed, relative RT scores (i.e., subtracting each participant's valence category mean RT scores from their checkerboard mean RT score) were computed for each of the three valence categories. It should be noted, however, that the original purpose of including RT in the

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[65] Similar to Study 2, findings from Carver and White's BIS/BAS Scales are included in Appendix Q. Only findings from Corr and Cooper's RST-PQ and Jackson-5 Scales are presented from this point forward.

[66] The Sphericity assumption was breached, χ^2 (5) = 11.30, $p = .046$, and therefore, the Greenhouse-Geisser statistics are presented.

oddball paradigm task was only to ensure that participants were attending to the images presented on the computer screen and, as such did not form part of the hypotheses.[67]

Bivariate correlations. There were moderate to strong significant negative relationships between CC BAS: Reward Reactivity and RT to the positive, negative, and neutral images; the same relationships were found between Jackson's FFFS and RT to the difference valenced picture images. Inconsistent with expectations, these findings indicated that stronger CC BAS: Reward Reactivity and Jackson's FFFS tendencies were both associated with faster responses towards all images independent of valence category (see Table 8.5). Further, there was a moderate to strong negative significant relationship between CC FFFS and reaction RT to neutral images, indicating that stronger CC FFFS tendency was associated with faster responses towards the neutral images (see Table 8.5).

Due to the moderate sample size (N = 16)[68] and associated restricted statistical power, only correlation statistics (r) greater than 0.3 were interpreted. Similar to the significant findings, these correlations indicated that RST traits, irrespective of whether they were BAS or FFFS traits, showed negative relationships (i.e., faster RT) with all valence categories of the picture stimuli (see Table 8.5). Overall, these findings are contrary to RST expectations, in which individuals who are more sensitive to rewards (i.e., stronger BAS) would show faster RTs towards the positive pictures compared to the negative and neutral images. In turn, RST would predict that individuals who are more sensitive to punishments (i.e., stronger FFFS) would show faster RTs towards the negative images than the positive or neutral images.

[67] The RT data are included for comparative purposes only (i.e., RT vs. ERP data).

[68] Sample sizes in EEG studies typically consist of an average of 15 to 30 participants (e.g., see meta-analysis by Olofsson et al., 2008). In previous marketing studies which have applied EEG, the sample sizes in various studies have ranged from 10 to 15 participants (e.g., Astolfi et al., 2008b; Vecchiato et al., 2010a, 2010b).

Table 8.5

Bivariate Correlations between the RST Traits and Relative Mean RT Valence Scores

	Negative images	Positive images	Neutral images
BAS scales			
CC BAS: Reward Interest	-.281	.062	-.089
CC BAS: Goal-Drive Persistence	-.217	-.025	-.093
CC BAS: Reward Reactivity	-.576*	-.541*	-.581*
CC BAS: Impulsivity	-.225	.031	-.111
CC Defensive Fight	-.104	-.316	-.157
J5 BAS	-.389	-.016	-.119
FFFS scales			
CC FFFS	-.493	-.374	-.515*
CC Panic	-.334	-.255	-.368
J5 FFFS	-.543*	-.606*	-.557*
J5 Flight	-.292	-.398	-.314
J5 Freezing	-.308	-.262	-.381

Note. CC = Corr and Cooper's RST-PQ; J5 = Jackson-5 Scales
* $p < .05$

8.7.4 Psychophysiological data

Valence effects. Given that previous research has reported that positive and negative images elicited larger mean amplitudes than neutral images (see Olofsson et al., 2008) and that the P300 response is more evident along the central-posterior midline (e.g., Johnson, 1993), valence and electrode location effects were first assessed independent of personality. A series of 3 (picture valence category: negative, positive, neutral) x 4 (electrode site: Fz, Cz, Pz, Oz) repeated-measures ANOVAs were undertaken to examine message processing via three ERP components: N100, N200, and P300. Tests of simple effects were used to follow-up all significant interactions. It should be noted that breaches of sphericity are common when analysing physiological data (see Picton et al., 2000) and when this assumption was breached, the Greenhouse-Geisser correction was applied.

N100. Mauchly's test of Sphericity revealed that this assumption had been breached for electrode location, χ^2 (5) = 46.08, $p < .001$ and the valence x electrode interaction, χ^2 (20)

= 35.74, p = .019 and thus, the Greenhouse-Geisser correction was applied to both electrode location (ε = .38) and to the interaction term (ε = .60). The main effect of valence approached significance, $F(2, 30) = 2.88$, $p = .072$, with a moderate effect size. There was a significant main effect of electrode location, $F(1.17, 17.47) = 4.55$, $p = .042$.

There was a significant valence x electrode location interaction on N100, $F(6, 90)$ = 7.64, $p < .001$. For the Fz electrode site, the pairwise comparison approached significance between the negative and positive stimuli, $M = -0.86$, $p = .096$, 95% CI [-1.83, 0.12], trending towards a greater N100 mean amplitude on presentation of negative images than positive images. Further, the comparison was approaching significance between the negative and neutral stimuli, $M = -1.18$, $p = .068$, 95% CI [-2.44, 0.07], trending towards a greater N100 mean amplitude on presentation of the negative images compared to the neutral images. For the Cz electrode site, there were no significant pairwise comparisons by valence. Since the interaction graph indicated that the N100 was not evident at either the Pz or Oz sites (i.e., as indicated by the zero/ positive microvolts for the picture stimuli at these two electrode locations; see Figure 8.4), comparisons were not interpreted for these two electrode locations.

N200. The Sphericity assumption was breached for electrode location, $\chi^2(5) = 31.74$, $p < .001$ and thus, the Greenhouse-Geisser correction was applied (ε = .62). While there was no significant main effect of valence, $F(2, 28) = 0.17$, $p = .849$, there was a significant main effect of electrode location, $F(1.53, 21.41) = 28.31$, $p < .001$. There was also a significant valence x electrode interaction, $F(6, 84) = 4.00$, $p = .001$. However, the follow-up analysis revealed that there were no significant pairwise comparisons between the valence conditions at the Fz or Cz sites. Similar to the N100, the interaction graph revealed that the N200 amplitude was only elicited at the Fz and Cz sites (i.e., as indicated by the negative microvolts for the picture stimuli at these two electrode locations; see Figure 8.5) and as such, comparisons were not interpreted at the Pz or Oz sites.

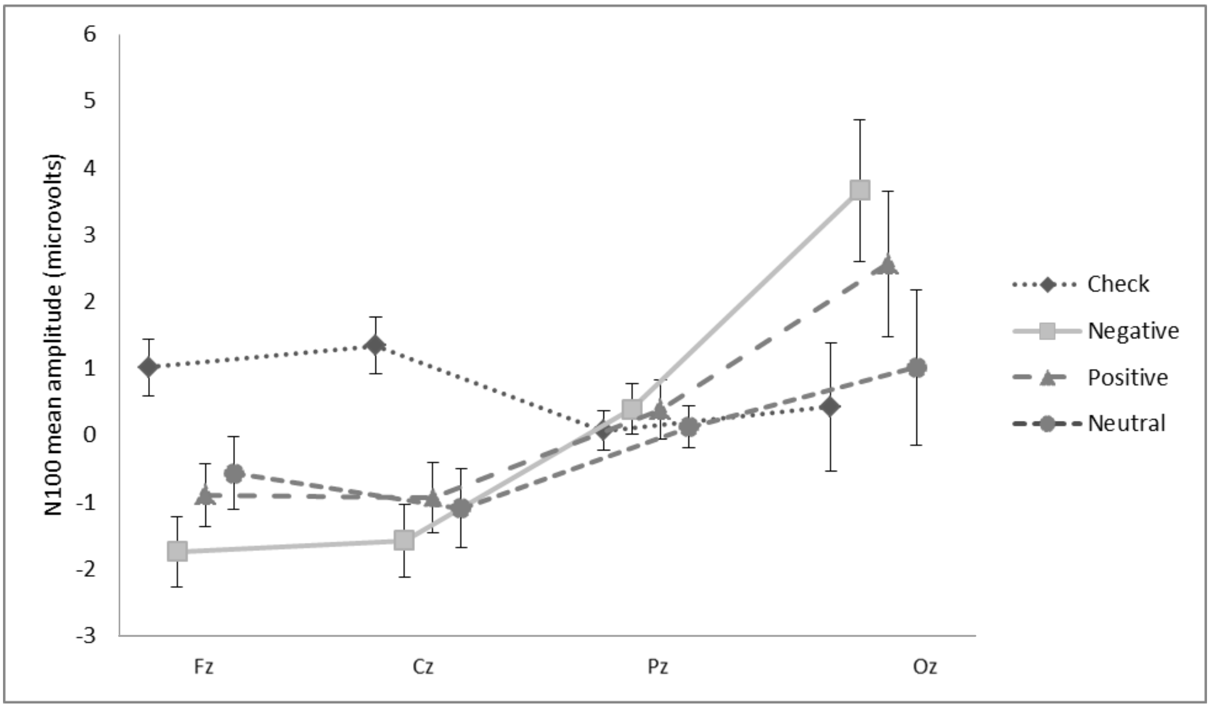

Figure 8.4. Picture processing (as measured by the N100 amplitude) as a function of valence and electrode location. Error bars represent 1 standard error.

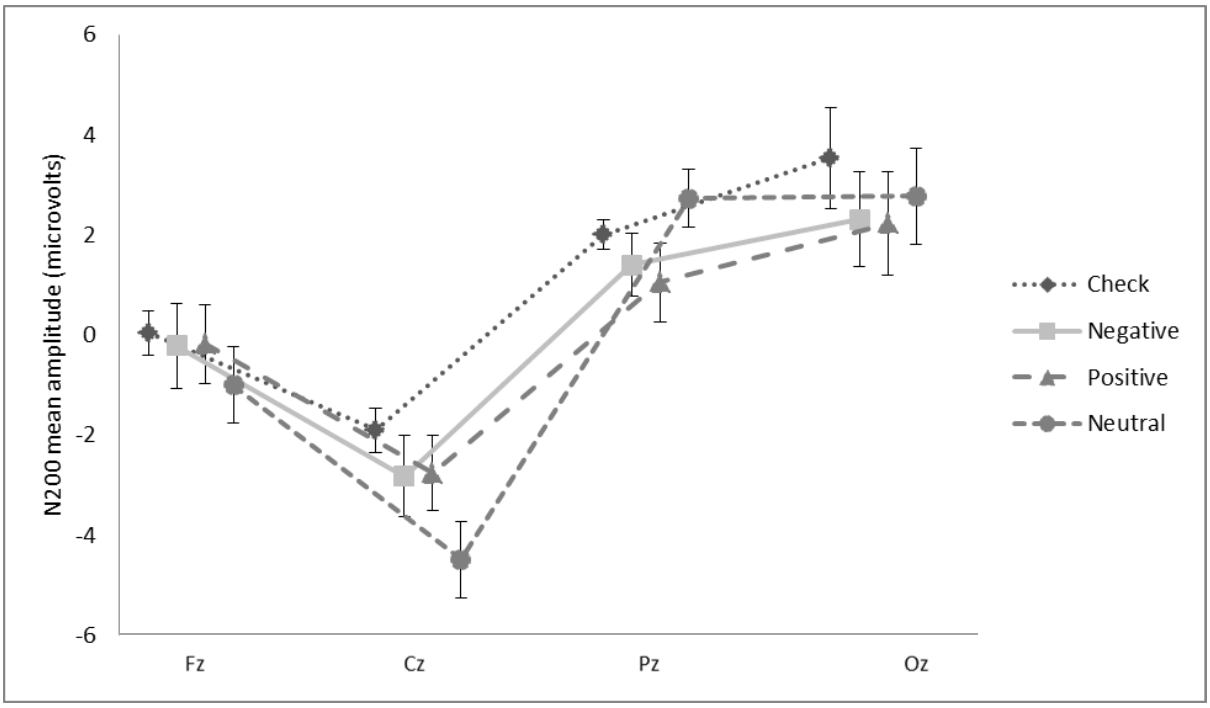

Figure 8.5. Picture processing (as measured by the N200 amplitude) as a function of valence and electrode location. Error bars represent 1 standard error.

P300. Mauchly's test of Sphericity revealed that this assumption had been breached for electrode location, χ^2 (5) = 22.54, p < .001 and the valence x electrode interaction, χ^2 (20) = 34.33, p = .028 and thus, the Greenhouse-Geisser correction was applied to both electrode location (ε = .62) and valence x electrode interaction (ε = .59). While there was no significant main effect of valence, F(2, 28) = 0.05, p = .953, there was a significant main effect of electrode location, F(1.85, 25.87) = 19.07, p < .001. A significant valence x electrode location interaction was also found, F(6, 84) = 2.83, p = .015. Since the P300 was only elicited at Pz and Oz electrode sites (i.e., positive microvolts for the picture stimuli only at the Pz and Oz electrode sites; see Figure 8.6), pairwise comparisons were only interpreted for these electrode sites. While there were no significant differences in P300 by valence at the Pz site, there was a significant difference between P300 responses to positive and neutral stimuli at the Oz site. This finding indicates that the positive images elicited significantly greater P300 mean amplitude at the Oz site than the neutral images, M = -1.59, p = .018, 95% CI [0.26, 2.93]. There were no significant differences in the P300 amplitude between the negative and neutral images at the Oz site, p = .464.

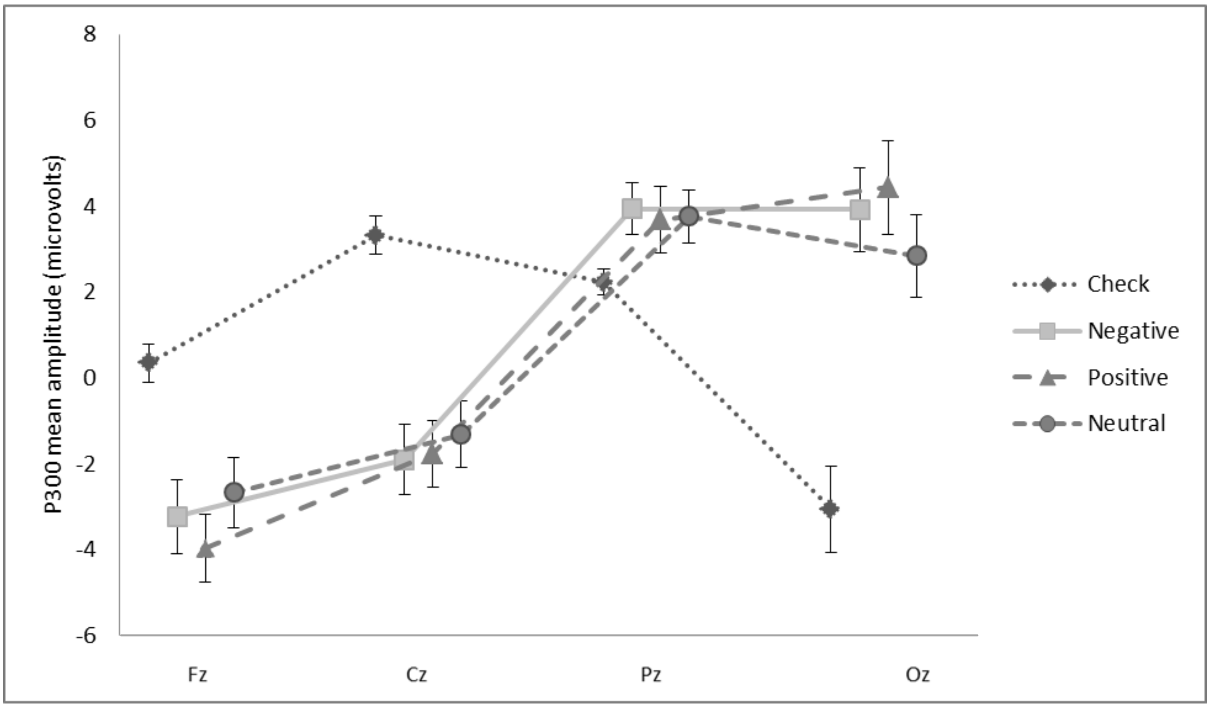

Figure 8.6. Picture processing (as measured by the P300 amplitude) as a function of valence and electrode location. Error bars represent 1 standard error.

RST trait effects. A series of one-way repeated measures ANOVAs were undertaken to test the effects of the individual BAS and FFFS traits on picture processing (ERP), as a function of valence category (controlling for differences to ERP checkerboard stimuli).[69] On the basis of the valence and electrode location findings in the previous section, the mean amplitudes at the N100 and N200 were examined for the Fz and Cz sites only, while the mean amplitudes at the P300 was examined for the Pz and Oz sites only.[70]

The significant findings ($p < .05$), along with those findings approaching significance ($p \leq .10$) are presented in Tables 8.6 and 8.7 and are discussed below. The remaining statistics ($p > .10$), are presented in Appendix R.

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[69] DV was image mean amplitude minus checkerboard mean amplitude.

[70] The N100 and N200 were not evident at the two posterior sites, while the P300 was not evident at the frontal and central electrodes.

Table 8.6

Significant ANOVA Effects of RST Traits and Valence on Picture Processing (ERP Response)

Effect	*F*	*p*	η^2
<u>Fz N100</u>			
Jackson's BAS and valence on processing (*n* = 16)			
BAS	4.85	.045	.25
Valence	2.83	.076	.15
BAS x valence	2.03	.150	.11
<u>Cz N100</u>			
CC BAS: Reward Interest and valence on processing (*n* = 16)			
Reward Interest	6.71	.021	.32
Valence	0.38	.689	.02
Reward Interest x valence	0.70	.506	.05
CC BAS: Reward Reactivity and valence on processing (*n* = 16)			
Reward Reactivity	6.10	.027	.30
Valence	0.65	.530	.04
Reward Reactivity x valence	0.76	.477	.05
Jackson's BAS and valence on processing (*n* = 16)			
BAS	7.91	.014	.36
Valence	0.77	.471	.05
BAS x valence	1.10	.346	.07
<u>Fz N200</u>			
CC BAS: Impulsivity and valence on processing (*n* = 15)			
Impulsivity	6.90	.021	.35
Valence	0.61	.552	.04
Impulsivity x valence	1.25	.303	.08
<u>Cz N200</u>			
CC BAS: Reward Reactivity and valence on processing (*n* = 15)			
Reward Reactivity	3.22	.095	.19
Valence	4.06	.028	.18
Reward Reactivity x valence	3.85	.033	.18
CC BAS: Impulsivity and valence on processing (*n* = 15			
Impulsivity	2.04	.175	.13
Valence	3.09	.061	.15
Impulsivity x valence	3.84	.034	.18

Note. CC = Corr and Cooper's RST-PQ

Table 8.7

ANOVA Trend Effects (p < .10) of RST Traits and Valence on Picture Processing (ERP Response)

Effect		F	p	η^2
<u>Fz N100</u>				
CC BAS: Reward Reactivity and valence on processing (n = 16)				
	Reward Reactivity	3.94	.067	.21
	Valence	0.33	.722	.02
	Reward Reactivity x valence	0.31	.737	.02
<u>Oz P300</u>				
CC FFFS and valence on processing (n = 15)				
	FFFS	< 0.01	.954	.00
	Valence	3.38	.050	.18
	FFFS x valence	2.57	.096	.14

Note. CC = Corr and Cooper's RST-PQ

N100: Fz electrode site. There was a significant main effect of Jackson's BAS on picture processing at Fz, indicating that higher BAS scores were associated with more pronounced N100 response at the Fz site, across valence categories. While there was no significant BAS x valence interaction, the size of observed effect was large. There were also no additional significant interactions or main effects of RST at the Fz site, which was not as anticipated. The main effect of CC BAS: Reward Reactivity on N100 at the Fz site was approaching significance, with size of the observed effect large and the direction of means similar to that of Jackson's BAS.

N100: Cz electrode site. There were significant main effects for three BAS traits on picture processing at Cz, all with large effect sizes: CC BAS: Reward Interest, CC BAS: Reward Reactivity, and Jackson's BAS, revealing that higher BAS scores were associated with a greater N100 mean amplitude at the Cz electrode site. However, similar to the Fz electrode site, there were no significant BAS nor FFFS trait x valence interactions on processing (as assessed via the N100), which was not supportive of expectations.

N200: Fz electrode site. There was a significant main effect of CC BAS: Impulsivity on N200 response to the pictures, with the simple slopes graph indicating that higher impulsivity scores were associated with higher mean amplitudes. While the CC BAS: Impulsivity x valence interaction was not significant, there was a medium effect size. Inconsistent with expectations, there were no other significant main effects of the BAS/ FFFS traits or trait x valence interactions at the Fz site.

N200: Cz electrode site. The main effect of CC BAS: Reward Reactivity was approaching significance, with a large effect size. There was a significant CC BAS: Reward Reactivity x valence interaction on N200 response at Cz (see Table 8.6), with the size of the observed effect large. The linear regression revealed a significant partial correlation between CC BAS: Reward Reactivity and pre-attention (N200) towards the negative images, r = .563,[71] p = .023, accounting for 31.7% of the variance. The simple slopes graph showed that individuals with higher BAS: Reward Reactivity showed a more pronounced N200 for the negative images (see Figure 8.7), opposite to RST-based expectations. The partial correlation between CC BAS: Reward Reactivity and neutral images approached significance, r = .477, p = .061, with a trend for higher CC BAS: Reward Reactivity scores to be associated with a more pronounced N200 to the neutral images. Inconsistent with expectations, there was no significant partial correlation between CC BAS: Reward Reactivity and the N200 response to positive images, r = .190, p = .481.

[71] All effect sizes presented for the liner regressions have been converted to r.

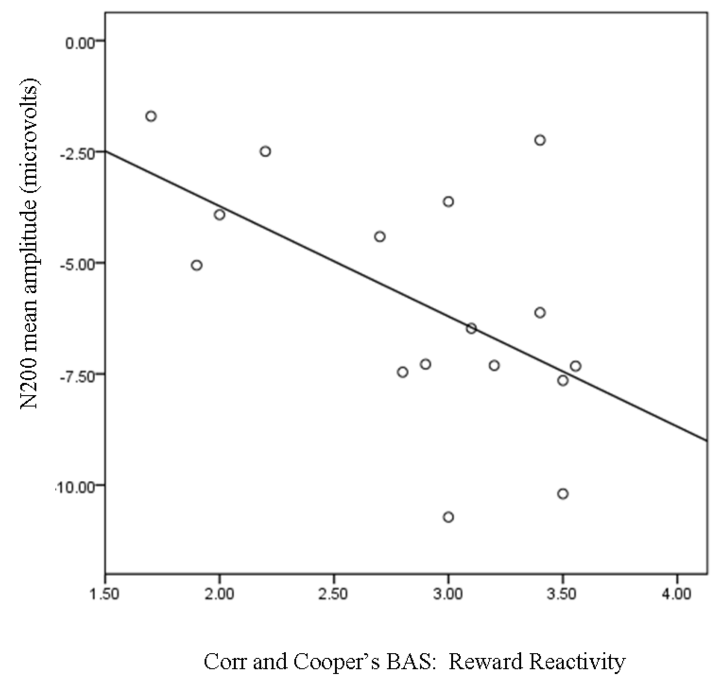

Figure 8.7. Partial correlation between BAS: Reward Reactivity and the N200 mean amplitude at the Cz electrode site for negative images.

There was also a significant CC BAS: Impulsivity x valence interaction, with the size of the observed effect large. Similar to CC BAS: Reward Reactivity, there was a significant partial correlation between BAS: impulsivity and N200 to negative images at the Cz site, r = .558, p = .025, accounting for 31.1% of the variance. The simple slopes graph showed that higher impulsivity was associated with a more pronounced N200 for these negative images (see Figure 8.8). There was no significant partial correlation between CC BAS: Impulsivity and positive images, r = .276, p = .300 or between CC BAS: Impulsivity and neutral images, r = .182, p = .502. There were no additional main effects of BAS/ FFFS or trait x valence interactions on picture processing (as assessed via the N200) at the Cz site.

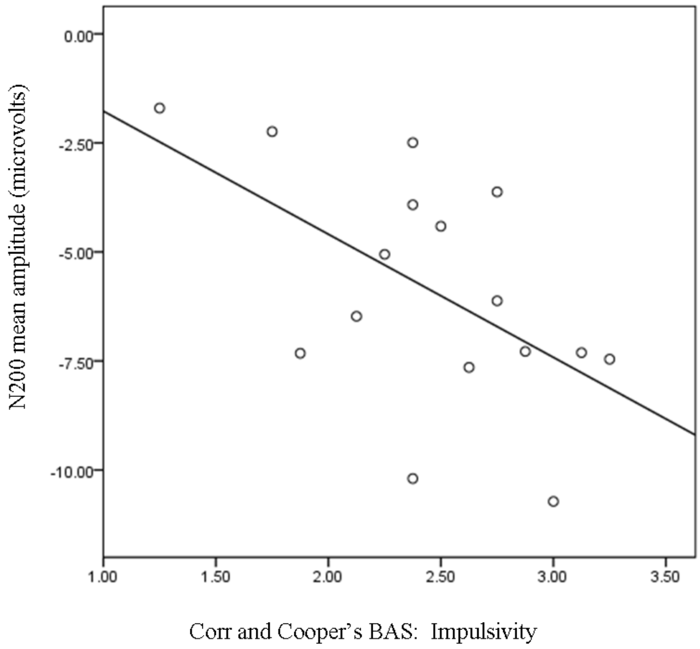

Figure 8.8. Partial correlation between BAS: Impulsivity and the N200 mean amplitude at the Cz electrode site for negative images.

P300: Pz and Oz electrode site. There were no significant main effects of the BAS traits nor BAS x valence interactions, nor were there any significant main effects of the FFFS traits or FFFS x valence interactions on the P300 response at the Pz and Oz electrode sites. The interaction between CC FFFS and valence approached significance, with a large effect size. However, there were no significant partial correlations between CC FFFS and picture stimuli (i.e., r = .184, p = .512 for the negative images, r = .161, p = .568 for the positive images, and r = .063, p = .817 for the neutral images). Thus, individual differences in reward and punishment sensitivities did not predict processing biases (i.e., greater P300 mean amplitudes recorded at the Pz electrode) towards the positive and negative still road safety images in this sample.

8.8 Discussion

This study extended upon Study 2 by incorporating a more sensitive objective measure of processing, the ERP, to supplement the LDT results of Study 2. Study 3b also involved exposing young drivers to emotional picture stimuli, taken from previously aired road safety advertisements, as opposed to Study 2's use of word stimuli. The aim of Study 3b was to examine if individual differences in BAS and FFFS sensitivities would be revealed as differences in mean ERP components (pre-attention and/ or processing) for positive and negative still images used in previous TAC anti-speeding campaigns. Four hypotheses were tested regarding relationships between valence and BAS/ FFFS traits. Overall, the findings did not support these RST hypotheses. For instance, the results showed that there were two BAS x valence interactions on pre-attentional processes (as assessed by the N200 mean amplitude) towards the negative images, but not towards the positive images as anticipated. Many of the BAS effects which approached significance, however, were of medium to large effect size, indicating that the results may have failed to reach significance because of the moderate sample size of 16 females. Due to the exploratory nature of this study the following discussion will only focus on the BAS/ FFFS traits. It is acknowledged that further RST research is required to assess the potential effect of the BIS trait on picture processing (via ERPs), in potentially conflicting cue contexts.

8.8.1 Valence and electrode location effects.

Based on previous research findings that positive and negative images elicited larger mean amplitudes than neutral images (see Olofsson et al., 2008) and that ERP responses are greater in specific neural regions (e.g., the P300 has been reported to be more evident along the central-posterior midline compared to other neural regions, Johnson, 1993), valence and electrode location effects were first assessed, independent of personality. Consistent with previous research (e.g., Codispoti et al., 2006), positive images elicited a greater P300 mean amplitude at the Oz electrode site than neutral images, indicating that individuals showed a processing bias towards the positive images compared to the neutral images.

Previous research has consistently shown that ERPs that occur prior to 500ms after stimulus onset are more susceptible to valence effects compared to those later ERPs (see Olofsson et al., 2008). Specifically, visual positive and negative stimuli have been found to produce larger ERP components within this time range compared to neutral stimuli. However, in Study 3b, this valence effect was only evident at the Oz site where a greater P300 was produced on presentation of the positive images than on presentation of the neutral images. A potential explanation for these somewhat discrepant findings may be that the participants in Study 3 were aware that they would view images that had previously been shown in road safety advertisements. In accordance with ethical approval for the study, the participants were informed of the potential risks associated with the study, one of which was exposure to images used as part of road safety advertisements (see Appendix S for the participant consent form). As previously discussed, traditional road safety advertisements shown in Australia have typically relied heavily upon threat-based appeals (e.g., threat of loss of life or other physical consequences associated with crash related injuries; Donovan & Henley, 1997; Donovan et al., 1999) and consequently, positive emotional-based road safety messages are relatively uncommon. Thus, participants might have expected to view negative images and as a result did not process the negative road safety images to the same extent as other images. In turn, participants might not have expected to view positive road safety images and consequently, showed greater processing of these more ‘novel’ images compared to the neutral images.[72]

[72] As previously mentioned, the neutral images were sourced from the internet and had not been previously used in road safety commercials.

8.8.2 RST and early to middle negative potentials.

Pre-attentive processes were examined, as a function of the BAS and the FFFS traits. While there were some main effects of the RST traits, they did not interact with valence in accordance with predictions. Therefore, the findings did not support H.1a or H1.b which predicted that individuals with stronger BAS traits would elicit larger N100 and N200 mean amplitudes towards the positive images (compared to weaker BAS individuals), while individuals with stronger FFFS traits would demonstrate greater N100 and N200 mean amplitudes (indicating greater attention) towards the negative images than individuals with a weaker FFFS. However, other unexpected relationships did emerge.

N100. Previous ERP research that has examined the BAS and the FFFS traits in the processing of emotional visual stimuli have used the P300 amplitude (e.g., Balconi et al., 2012; De Pascalis et al., 2004; Nijs, Franken, & Smulders, 2007). However, one study which assessed pre-attentive processes via the N100, found that individuals who were more sensitive to rewards (as assessed by CW BAS: Reward Responsiveness) elicited a larger N100 mean amplitude on presentation of positive picture stimuli relative to neutral picture stimuli along the central-parietal midline neural regions (Gable & Harmon-Jones, 2013). These findings are inconsistent with the current results, where no significant BAS x valence interactions were observed to positive pictures compared to neutral or negative pictures.

Gable and Harmon-Jones (2013) recruited a large sample of 43 female participants, while Study 3b consistent of a moderate sample size of 16 females. In the current study, a large proportion of the BAS/ FFFS effects on picture processing (as assessed by the N100 and N200 mean amplitudes) that failed to reach significance showed medium to large effect sizes (see Appendix R), suggesting that Study 3b was statistically under powered, which could potentially account for the differences between these two studies. However, despite the current CW BAS: Reward Responsiveness findings failing to reach significance, the means were in the same direction as those of Gable and Harmon-Jones (2013) at the Cz electrode site. Due to the exploratory nature of this study, only a modest sample of participants was recruited and thus, further research is required to test these effects with a larger, more representative sample of young drivers.

An additional explanation for the differences in results between Gable and Harmon-Jones (2013) and Study 3b could be because of the difference in experimental tasks (i.e., passively viewing picture stimuli for six seconds in Gable and Harmon-Jones vs. viewing stimuli for one second in anticipation of a response in the visual oddball task in the current study) and the number of picture stimuli (i.e., 32 positive images in Gable and Harmon-Jones vs. 24 positive images in the current study). However, given that ERPs are elicited on presentation of picture stimuli, extra viewing time should not have influenced the P300 response. Further, while the grand averages were based on a larger number of pictures in Gable and Harmon-Jones, previous research has argued that the number of picture stimuli is of little difference in grand average mean amplitudes after 20 images (see Cohen & Polich, 1997). Similar to the current findings, however, Gable and Harmon-Jones (2013) found no significant differences in attention towards positive images, as a function of CW BAS: Drive and CW BAS: Fun Seeking. Due to these mixed findings and lack of further comparative research in this area, more research is required to replicate these studies to clarify the potential influence of RST traits on picture processing (via ERPs).

N200. Female drivers with stronger CC BAS: Reward Reactivity and CC: BAS Impulsivity traits demonstrated significantly larger N200 mean amplitudes (indicating greater automatic attention) on presentation of the negative images than those with weaker BAS traits, at the Cz electrode site. Gray and McNaughton's (2000) RST predicts that individuals with a stronger BAS should be more sensitive to rewards, in this case positive images, compared to those individuals with a weaker BAS. The current findings, however, found no significant BAS x positive valence interactions and thus, are not in line with the theoretical predictions of the revised RST.

There has been a lack of empirical research that has examined the underlying BAS constructs. The BAS is multidimensional system which consists of various underlying processes. For instance, according to Corr and Cooper (2013), the BAS consists of four underlying processes: two processes that relate to early approach behaviours (reward interest and goal-drive persistence) and two processes that relate to later approach behaviours (reward reactivity and impulsivity). The current finding revealed that while later approach behaviours resulted in greater pre-attentional processes towards the negative images, there were no similar findings in regards to the earlier approach behaviours. Given that previous research in the health communication field has reported different associations between the BAS processes and various risky health behaviours (see chapter 7, section 7.6.1; Voigt et al., 2009) more research is required to assess these processes independently of the whole BAS construct. Identifying which BAS processes may influence message processing and subsequent message acceptance, may provide insight into how to target high risk drivers through message design.

In term of road safety advertising, Study 3b findings provide some support for using negative emotional-based images in road safety advertisements. Previous research has found that female drivers are more likely to be persuaded by physical threat-based messages (e.g., Goldenbeld et al., 2008) than male drivers, whom are more likely to find positive emotional-based approaches more persuasive (see Lewis et al., 2009). Further, considering that young male drivers are more likely to report speeding behaviour compared to their female counterparts (e.g., Horvath et al., 2012a) more research is required to replicate this design using a similar number of males to examine potential gender differences that may influence pre-attention and/ or processing road safety images.

Despite individuals with stronger CC BAS: Reward Reactivity and CC BAS: Impulsivity traits allocating greater automatic attention towards the negative images (N200), these individuals did not demonstrate greater processing of these negative images (as assessed by the P300 mean amplitude). A potential explanation for this inconsistency may relate to the content contained in the negative images. For instance, previous research has reported that individuals are more likely to allocate greater early automatic attention towards negative picture stimuli than positive picture stimuli (e.g., Luo et al., 2010). Thus, regardless of individual differences in BAS and FFFS traits, negative stimuli may initially elicit greater N200 responses.

8.8.3 RST and P300

The results of the P300 analyses did not support H.2a or H2b, which predicted that individuals with a stronger BAS (compared to weaker BAS) would elicit a larger P300 mean amplitude (greater processing) towards the positive images, while those with a stronger FFFS would demonstrate a greater P300 mean amplitude towards the negative images compared to those with a weaker FFFS. These null findings are inconsistent with previous research that has found such effects for BAS and original BIS traits, respectively (e.g., Balconi et al., 2012). However, similar to these findings in Study 3b, Gable and Harmon-Jones (2012) found no significant effect of BAS on processing of positive images (as assessed by the P300 mean amplitude at three electrode sites: CPz, Cz, and Pz).

A potential explanation for these discrepant findings may relate to the different definition of the P300 ERP time windows. For instance, Balconi et al. (2012) defined the P300 as the mean amplitude that occurred between 300-400ms after stimulus onset, while Gable and Harmon-Jones (2013) and the present study both defined the P300 as the mean amplitude that occurred between 300-500ms after stimulus onset. Further, while Balconi et al. (2012) relied on correlations, both Gable and Harmon-Jones (2013) and the current study applied a within-groups design using difference scores (i.e., positive minus neutral values in Gable and Harmon-Jones and positive/ negative minus checkerboard values in the present research), providing a more sensitive measure of potential RST differences. However, inconsistent with the theoretical predictions of the BAS, Balconi et al. (2012) also reported a significant moderate positive correlation between CW BAS: Drive and the processing (as assessed by LPP; defined as the mean amplitude between 400-600ms after stimulus onset) of highly arousing negative images (i.e., images with arousal ratings of 6.56, measured on a 9-point Likert Scale). Balconi et al. (2012) findings indicate that higher CW BAS: Drive scores were associated with greater processing of negative images. This finding further demonstrates the inconsistencies in RST/ ERP findings using visual image stimuli.

Alternatively, the type of positive stimuli used in Study 3b may account for the absence significant BAS effects. For instance, while these images were rated to be of a positive nature in Study 3a (see section 8.5.1), participants may have not associated these images with incentive/ reward cues. Given that the BAS is activated on presentation of reward cues (Gray & McNaughton, 2000), the positive stimuli from road safety advertisements may not have been reinforcing enough to activate this system. Thus, to ensure that the stimuli are associated with rewards/ incentive cues in future health advertising research, research may consider presenting the positive-based advertisement(s) to prime the images used as target stimuli in the subsequent cognitive ERP task. An explanation for why the FFFS effects on P300 failed to reach significance may be due to the nature of the sample (i.e., modest sized, female only sample). Previous research has reported that females tend to have higher self-reported punishment scores than males (e.g., Heponiemi, Keltikangas-Järvinen, Puttonen, & Ravaja, 2003; Jackson, 2009; Mardaga & Hansenne, 2007; Wright, Hardie, & Wilson, 2009),[73] a finding that was evident in Study 2 (see Appendix L). Thus, examining a female only sample may have potentially reduced the variability of the self-reported FFFS scores and consequently, any potential FFFS effect on picture processing may not have been detected. However, the variability on the self-reported FFFS scores in Study 3b and Study 2 were similar, despite Study 2 consisting of both male and female participants (with the exception of Jackson's Fight scores which had larger variability in Study 2 than Study 3b). Alternatively, the FFFS results may have been influenced by the low FFFS scale reliabilities. While all of the BAS scales showed acceptable reliability (i.e., $\alpha > .70$; with the exception of BAS: Impulsivity which was slightly under .70 at, $\alpha = .67$), CC Panic, Jackson's FFFS and, Jackson's Freezing scale reliabilities were less than ideal (see section 8.7.1; with Jackson's Fight scale removed from further data analyses). Thus, these scales may not have been adequate measures of the FFFS constructs and potentially, contributed to the lack of significant FFFS effects. Further research is required to replicate Study 3b by using a more reliable scale.

Only recently has research begun to report the use of ERPs to examine the potential influence of RST traits on emotional picture processing. More research is required to examine if the BAS/ FFFS effects are evident in earlier attentional processes (as found in Gable & Harmon-Jones's, 2013 study and Study 3b) or later ERPs that are associated with higher order cognitive processing (as per Balconi et al., 2012). In a health advertising context, continuing to examine the attention and/ or processing of positive and negative emotion-based road safety advertisements as a function of RST traits, may also have important implications for designing more effective messages to target high risk individuals, particularly young drivers who may be more sensitive to rewards.

[73] Research based on CW BIS or Jackson's FFFS Scales. Further, Jackson found that females had higher Flight and Freezing trait scores compared to males, while males had higher Fight scores than female participants. In the current study, Fight was removed from the data analysis due to unacceptably low internal reliability.

8.8.4 Behavioural vs. psychophysiological data

The findings revealed some inconsistencies between the behavioural RT data and psychophysiological data. For example, the behavioural data revealed a strong significant negative relationship between the CC BAS: Reward Reactivity scores and relative RT to all picture stimuli, suggesting that those individuals higher in CC BAS: Reward Reactivity were more likely to process all pictures (vs checkerboards) to a greater extent, regardless of valence. In contrast, the ERP findings revealed that individuals with a stronger CC BAS: Reward Reactivity elicited a greater N200 on presentation of the negative picture stimuli, indicating greater pre-attention towards the negative images; no significant follow-up associations were found for the positive or neutral images. Further, in contrast to the RT findings, there were no significant effects of CC BAS: Reward Reactivity on pre-attention towards the positive or neutral images (as assessed via N200), nor were there any significant effects on processing of the picture stimuli (as assessed via the P300).

As discussed in chapter 7, section 7.6.1, compared to behavioural measures of processing, ERPs are considered a more sensitive measure of cognitive processing as they are able to detect earlier processing responses and are not affected by a participant's motor responses (e.g., RT; Thorpe et al., 1996). In the current study, the mean RT range was 492-502ms after picture onset, indicating that, on average, participants had similar RTs towards all picture stimuli regardless of the valence category. Similar to Study 2, these findings may reflect the presence of a ceiling effect (i.e., demonstrate faster RTs to all picture stimuli, despite the valence condition) and thus, may not capture differences in picture processing. The ERP data, however, was able to detect differences in earlier attentional processes (i.e., N100 and N200), without the intrusion of delays in motor responses. These findings highlight the added benefits of including a more sensitive measure of attention and/ or processing to further assess individual differences in message processing.

Self-report scales are typically used to assess individual differences in the BAS, FFFS, and BIS (e.g., Carver and Whites BIS/BAS Scales, Corr and Cooper's RST-PQ, and Jackson-5 Scales, to name a few; see chapter 2, section 2.4 for an in-depth overview of these measures). However, as outlined in chapters 2 and 3, some of the previous research which has used self-report measures to assess the RST traits has reported conflicting results. The RST postulates that the nervous system regulates behaviour and that individuals differ as to whether they are sensitive to rewards or punishments (Gray & McNaughton, 2000). Self-report measures may not be sensitive enough to assess the underlying neural processes that are associated with the RST traits and thus, may account for the inconsistencies in the RST literature. Alternatively, the inconsistent findings may reflect that the self-report measures are designed to essentially measure different BAS, FFFS, and BIS processes. For instance, Corr and Cooper's RST-PQ measures four facets of the BAS (i.e., Reward Interest, Goal-Drive Persistence, Reward Reactivity, and Impulsivity) and the FFFS construct. Jackson-5 Scales include one global measure to assess each of the BAS and BIS constructs and three scales to assess the individual FFFS processes (i.e., Fight, Flight, and Freeze). It was beyond the scope of this research to evaluate the various measures. However, given that there is no one standard measure that is used to assess the RST processes, an overall evaluation of the available psychometric RST assessments should be undertaken in future research to systematically examine construct validity and reliability of these different scales.

8.8.5 Limitations and future research

While the author had intended to include both males and females in the main data analysis, due to the small number of male participants who responded to the recruitment requests and to prevent gender confounding results, only the data of females were analysed and discussed in Study 3b. As previously stated, research has reported that gender can influence neural responses (e.g., Gasbarri et al., 2007) and thus, as recommended by Picton et al. (2000), EEG studies should ideally include an equal number of males and females or include only males or females to control for gender effects. Similarly, since education has also been reported to influence ERP responses (see Picton et al., 2000), the participants were only recruited from a university population. However, by only including a well-educated female sample, the current findings cannot be taken to be representative of the general population. Further research is required to replicate this study using a sample size that consists of both male and female participants, from different populations.

In addition, it must be noted that while most of the RST self-report scales used in Study 3b showed acceptable internal consistency, several RST scale reliabilities were less than ideal ($\alpha < .70$), despite the removal of scale items. As previously indicated, the moderate sample size may have reduced scale reliability (Ponterotto & Ruckdeschel, 2007), since the RST scales had shown acceptable reliability in Study 2 and in previous research (e.g., Corr et al., 2013; Jackson, 2009). Given that these Study 3b scales lacked internal consistency, the scales may not have been reliable measures of the RST constructs. To enhance reliability of the data, further research should recruit a larger sample size to evaluate potential RST effects on message processing.

Emotional pictures which are perceived to be more arousing have been found to elicit larger ERPs than those emotional pictures which are perceived to be lower in arousal (e.g., Rozenkrants et al., 2008; Schupp et al., 2007). The findings from Study 3a indicated that female participants were significantly more likely to show higher mean arousal ratings to the pictures used in Study 3b than male participants, although all picture mean arousal ratings were less than 4 on a 7-point semantic differential scale. However, given that arousal has been reported to influence later ERPs (i.e., >500ms after stimulus onset; see section 8.2.1), the current findings should not have been confounded by arousal as all mean amplitudes that were evaluated in this study were under 500ms. However, future research should aim to minimise arousal differences in experimental picture stimuli, thus ensuring that arousal does not potentially influence the ERP responses.

Consistent with previous personality research (e.g., Li et al., 2005; Mardaga & Hansenne, 2009), each picture condition consisted of 24 images. However, it has been argued by others (see Luck, 2005) that between 30 and 60 picture stimuli should ideally be included in each condition to assess the P300 response. In Study 3b, while there was an abundance of negative anti-speeding advertisements to select negative images stimuli, there were only five positive anti-speeding advertisements that were available to select positive images from. Thus, a reduced number of images were able to be selected for the oddball paradigm task. Further, the current study did not alter or control for the brightness of the selected images. Previous research has reported that picture brightness can influence how images are perceived (Lakens, Fockenberg, Lemmens, Ham, & Midden, 2013; Reber, Winkielman, & Schwarz, 1998). For instance, brighter images are generally perceived by individuals to be more positive, while darker images tend to be perceived to be more negative. Arguably, since one of the purposes of this research was to examine actual images that had been previously included in anti-speeding campaigns, controlling for picture brightness could have potentially influenced participants' perceptions of these images. One issue with applying cognitive based measures to examining health communication messages is controlling for all the potential stimuli confounds (e.g., matching the picture and/ or word content between message conditions). As such, researchers are required to weigh up the benefits and limitations and ensure that controlling for these confounds does not substantially affect the ecological validity of the research or alternatively, the internal validity of the design.

An additional limitation was that the current study did not control for advertisement exposure outside the context of this research. For instance, viewing road safety advertisements prior to participating in this experiment might have influenced how individuals perceived the negative and positive images that were taken from previous road safety advertisements for inclusion in the ERP task. However, to reduce the effect of this potential confound, images were selected from previous TAC of Victoria televised campaigns (as opposed to campaigns previously aired in Queensland, where the sample were recruited and the research was being conducted) to limit the potential that participants had previously viewed these road safety advertisements. Future research should control for advertisement exposure by including an additional self-report measure to assess previous exposure of similar advertisements.

Finally, it is acknowledged that the implications of findings from Study 3b are limited due to the exploratory nature of this research design. As previously mentioned, this study requires replication using a more representative sample of both male and female drivers. Future research should also consider expanding on the current study by exploring in more depth, the potential impact that the BIS may have on processing a mixture of positive and negative picture stimuli (assessed via ERPs). Including all three motivational systems in the design; the BAS, the FFFS, and the BIS, would enable a greater understanding of the potential effects of individual differences in the RST traits on processing of picture-related message stimuli.

8.9 Chapter Summary

Chapter 8 presented the final two studies (i.e., Study 3a and 3b) of this research program which were designed to extend upon Study 2 by exposing young drivers to picture stimuli, taken from real road safety advertisements and using a more sensitive objective measure of processing, ERPs. Study 3a aimed to assess if the positive and negative picture stimuli would be suitable to activate the BAS and the FFFS traits in Study 3b, by evaluating the valence and arousal of the picture stimuli. Study 3b assessed the extent to which individual differences in BAS and FFFS may influence ERP responses to positive and negative still images used in previous road safety campaigns. The key findings from Study 3b indicated that individuals with stronger CC BAS: Reward Reactivity and CC BAS: Impulsivity traits elicited larger N200 response at the Cz electrode on presentation of the negative images, indicating greater pre-attention towards those images. There were no additional significant RST effects for picture processing.

As highlighted in this discussion, the findings are mixed on the involvement of the BAS and the FFFS traits on pre-attention and higher order cognitive processing of emotional images. In relation to road safety advertisements, and, health communication messages more broadly, limited research has applied ERPs to assess pre-attention and cognitive processing of advertisements. Applying psychophysiological measures to assess message processing may provide a more comprehensive picture of message processing and thereby enable campaign designers to more effectively create messages for their target audience and thus, enhance message persuasiveness.

Chapter 9. Overview, Critical Evaluation, and Conclusions

9.1 Chapter overview

This chapter provides an overview of the research program presented in this dissertation. A summary of the research program is first presented, prior to integrating the key findings that emerged from the six studies presented in chapters 6, 7, and 8. This chapter then discusses the strengths and limitations of this research while providing recommendations for future research. Finally, this chapter highlights the theoretical, methodological, and practical implications that this research has contributed to current understanding of the revised Reinforcement Sensitivity Theory (RST) and health communication.

9.2 Summary of research program

This research program has made an original contribution to knowledge in two key research areas: Gray and McNaughton's (2000) revised RST and in persuasive health communication, focusing specifically on road safety messages. This research extended upon Kaye et al. (2013) which had examined the Behavioural Approach System (BAS) and Fight-Flight-Freeze System (FFFS) and message framing effects, by recruiting a sample of younger drivers to examine the influence of all three RST traits on the relative effectiveness of message framing manipulations. To the best of the author's knowledge, this program of research was the first to assess the revised Behavioural Inhibition System (BIS) in the context of road safety messages, and the first to use Event-Related Potentials (ERPs) to assess individuals' processing of these persuasive messages in a road safety advertising context.

There were two overarching aims of this program of research. The first aim was to examine the extent to which individual differences, as conceptualised by Gray and McNaughton's (2000) revised RST traits (i.e., BAS, FFFS, and BIS), influenced young drivers' processing and subsequent acceptance of text-based gain-framed and loss-framed anti-speeding road safety messages alone and in conjunction with a message for a high performance vehicle. Studies 1a-c and 2 were undertaken to achieve this aim. Specifically, the overall purpose of Study 1 was to pilot and refine the four road safety messages and the motor vehicle message for their utility in Study 2 to activate the RST traits. In Studies 1a and 1b, a sample of young drivers were recruited to assess the validity of the message stimuli by completing online self-report questionnaires. In Study 1c, a mixture of focus groups and individual interviews were undertaken to further explore participant perceptions of the road safety messages and motor vehicle message. Based on the findings from Studies 1a and 1c, slight changes were made to the physical message stimuli to increase the likelihood that the perceived valence of these stimuli would be similar to that of the social messages (i.e., because the participants in Study 1a rated the words in the physical message to be slightly more negative than the words in the social messages). Further, some participants reported in the group discussions that they perceived the physical messages to include social cues and as such, these messages were altered to ensure that they only contained physical cues.

Using self-report and objective measures of RST, Study 2 examined the extent to which individual differences in RST traits influenced processing and persuasive outcomes of the revised road safety messages and a motor vehicle message. In Study 2, a computerised lexical decision task (LDT) assessed processing of the words taken from the message stimuli, and self-report measures assessed message acceptance. Overall, the results indicated some significant moderate positive relationships between the BAS and the FFFS traits and message acceptance of the gain-framed and loss-framed messages, respectively, consistent with predictions. However, unexpectedly, there were no significant relationships observed between these RST traits and message processing. The results also found that the BIS was activated on presentation of mixed message cues, as indicated by slower reaction times (RTs) to the words from the social loss-framed message in the LDT.

The second overall aim of the research was to assess if individual differences in the BAS and the FFFS traits influenced young drivers' processing of positive and negative still images used in previously televised Australian road safety advertisements. Studies 3a and 3b were undertaken as exploratory studies to assess this research aim. Study 3a refined the selection of the picture stimuli, with the 24 most negative, 24 most positive, and 24 most neutral images selected to be included in the computerised oddball paradigm task in Study 3b. Study 3b assessed if individual differences in the BAS and the FFFS traits influenced both pre-attentional processes (as assessed by N100 and N200) and cognitive processing (as assessed by P300) towards the positive and negative picture stimuli, respectively. Contrary to RST-based expectations, the key findings from Study 3b revealed that stronger BAS individuals elicited larger N200 towards the negative picture stimuli than weaker BAS individuals. No other significant RST by valence interactions were found in Study 3b.

9.3 Integration of key research findings

Over half of the young drivers in each research study reported regularly driving over the posted speed limit[74] and young drivers in Study 2 perceived themselves to be less risky and less likely to be involved in a speed related crash than 'a typical young driver'. Given that young drivers are over represented in driving related crashes (BITRE, 2013), these findings suggest that the road safety messages, motor vehicle message, and picture stimuli used in this research which all related to speeding, were likely to be relevant to the recruited sample of young drivers. Previous research has reported that personality characteristics influence driving behaviour (e.g., Harbeck & Glendon, 2013) and as such, the focus of the current research program was to examine the relationships that the BAS and the FFFS traits had on message processing and subsequent message acceptance of gain-framed and loss-framed anti-speeding messages in a young driver population.

[74] Except for Study 3a, where speeding behaviour was not assessed.

Young drivers who were more sensitive to punishments (stronger FFFS) reported higher acceptance of the loss-framed messages, while participants who were more sensitive to rewards (stronger BAS) reported higher acceptance of the gain-framed messages. Further, more impulsive (CC BAS: Impulsivity) individuals reported greater effectiveness of the physical gain-framed message, while higher CC BAS: Goal-Drive Persistent individuals reported more favourable attitudes towards the social gain-framed message. Consistent with the theoretical predictions of the BAS, these effects were not observed for the corresponding loss-framed message conditions. Trends were also found for several BAS x framing interactions for the physical condition (i.e., CC BAS: Reward interest x framing on attitudes, CC: Impulsivity x framing on message compliance, Jackson's BAS x framing on attitudes and behavioural intentions). The direction of the follow-up associations indicated that higher BAS scores on these scales tended to be associated with greater ratings of message acceptance for the physical gain-framed message, with no significant effects found for the physical loss-framed message. Together with the FFFS correlations, these findings suggest that individual differences in reward and punishment traits may influence how young drivers accept gain-framed and loss-framed road safety messages.

Given that personality traits are stable and unlikely to change, a range of road safety messages can be designed to target individual differences in reward and punishment sensitivities. Designing a range of road safety messages that align with different personality types (i.e., gain-framed messages for stronger BAS individuals and loss-framed messages for stronger FFFS individuals) may increase message persuasiveness, particularly for those who are most at risk. Consistent with previous research (e.g., Constantinou et al., 2011; Scott-Parker et al., 2012, 2013), the current findings revealed that those who were more sensitive to rewards (as measured by CC BAS: Reward Interest, CC BAS: Impulsivity, and CC Defensive Fight) reported greater engagement in risky driving practices compared to those less sensitive to rewards. Further, Study 2 found that these individuals were more likely to perceive themselves to have a greater crash risk than ‘a typically young driver’. Thus, introducing gain-framed messages (alongside the traditionally used loss-framed/ threat-based messages) may increase message persuasiveness for these at-risk young drivers, and ultimately, may reduce risky driving behaviour.

Despite these significant findings regarding message acceptance, individual differences in BAS and FFFS did not significantly influence message processing in Study 2. However, in Study 3b, participants with stronger CC BAS: Reward Reactivity and CC BAS: Impulsivity traits demonstrated greater pre-attentional processes towards the negative images (as measured by the N200) than those individuals with weaker BAS traits. This finding is inconsistent with RST-based expectations, however, which would have predicted that individuals with stronger BAS traits would show greater processing biases towards positive images instead of negative images. Given the modest sample size in Study 3 (N = 16, females only) and low internal consistency on several of the RST self-report scales, more research is required to replicate this study with a larger sample including males to further examine pre-attentional and cognitive processing of positive and negative pictures, as a function of RST traits.

In order to induce goal conflict to activate the BIS, participants in a separate Study 2 condition were exposed to both a social loss-framed message (highlighting the negative consequences of speeding behaviour; FFFS) and a motor vehicle message (promoting a high performance vehicle, capable of reaching high speeds; BAS). The findings indicated that individuals with stronger BIS traits showed slower RTs (inhibited behavioural responses) to the social loss-framed message when it was paired with the motor vehicle message than when the social loss-framed message was presented on its own. In other words, these findings may suggest that individuals with stronger BIS traits may show altered processing of road safety messages in a context containing competing, conflicting messages such as those presented in motor vehicle advertisements designed to highlight the capabilities of a vehicle. Further, individuals with stronger CC Panic and CC FFFS scores were more likely to perceive the social loss-framed message as being more effective when it was paired with the motor vehicle message, than those with weaker trait scores on these measures. These findings may suggest that stronger BIS/ FFFS individuals allocate greater attention towards the negative stimuli and thus, such findings are consistent with the theoretical underpinnings of the revised BIS and FFFS.

While these findings are consistent with the revised BIS (i.e., inhibited behavioural response on presentation of conflicting reward and punishment cues) and demonstrate this effect within the road safety advertising context, the findings highlight that young drivers' with stronger BIS: Anxiety traits may be less likely to process road safety messages in the context of competing, conflicting advertisements. Considering that road safety messages are typically forced to compete for individuals' attention with motor vehicle advertisements, the latter which may include some promotion of speeding, the context of competing messages may mean that individuals with stronger BIS: Anxiety traits are not persuaded by road safety messages. The findings support the need for regulatory bodies to pay careful attention to the impact of competing (advertising) messages which may negatively impact one's behaviour. This effect is not only likely to occur within the context of road safety advertising versus motor vehicle advertisements but, also potentially for other health-related behaviours, such as, healthy eating campaigns versus. fast-food commercials. The impact of mixed messages may have a detrimental effect on those individuals with stronger BIS: Anxiety traits and therefore, it is imperative that a range of countermeasures are not only designed to target those individuals who are sensitive to rewards and punishments but, also those individuals who have stronger BIS: Anxiety traits.

9.4 Strengths, limitations, and future research directions

9.4.1 Strengths of the research program

With the exception of Kaye et al. (2013), previous research that has applied RST-based approaches to assess health communication campaigns have relied upon Gray's (1972, 1987) original definitions of the BAS and the BIS. The current research contributed to the literature by examining the extent to which individual differences in the revised BAS and FFFS traits influence young drivers' processing and subsequent message acceptance of gain-framed and loss-framed anti-speeding messages, respectively. Further, instead of examining the higher-order BAS and FFFS constructs as per previous health communication research, Studies 2 and 3b examined the individual RST trait components. Previous research has reported that the BAS is a multidimensional system consisting of various underlying processes (see Carver & White, 1994; Corr & Cooper, 2013), while the FFFS consists of three independent responses: Fight, Flight, and Freezing.

Study 2 was also designed to assess the role of the BIS by exposing young drivers to two conflicting message stimuli sets; a social loss-framed message and a motor vehicle message. The BIS is activated upon presentation of conflicting information, such as punishment stimuli (e.g., social loss-framed message designed to activate the FFFS) and reward stimuli (e.g., motor vehicle message designed to activate the BAS). By assessing the role of the BIS in Study 2, a more comprehensive evaluation of the three motivational systems of the revised RST was achieved. As previously indicated, in the road safety context, the Australian media environment comprises both road safety messages, designed to prevent unsafe driving behaviours and motor vehicle advertisements, which may indirectly promote unsafe on road behaviours. Consequently, these motor vehicle advertisements may indirectly influence individuals' message acceptance of road safety messages given potentially conflicting messages sharing the same media space. Thus, with an examination of the BIS, Study 2 was able to explore the potential effects that mixed message cues may have on young drivers' processing and subsequent acceptance of road safety messages.

Study 2 examined processing of written message stimuli via a LDT task, while Study 3 built upon the design of Study 2 by including pictorial stimuli to assess processing via ERPs. Limited research has applied objective behavioural measures to assess message processing, as a function of RST traits. Further, to the best of the author's knowledge, this is the first study to assess message processing via ERPs in a road safety advertising context. As previously mentioned, marketing studies have been incorporating psychophysiological approaches to examine the effectiveness of product and brand advertisements over the past 10 years (see chapter 5). However, research in the health communication field has only recently started to apply these objective measures to further understand message processing and message acceptance (e.g., Falk et al., 2010, 2011; Kessels et al., 2011). Despite the exploratory nature of Study 3b, the current research has contributed to the road safety literature by highlighting the added benefits that more sensitive objective measures, such as ERPs, can provide to current insights into how drivers process road safety advertisements.

9.4.2 Limitations and future research directions

Despite best efforts to recruit a higher proportion of young male drivers, the current sample comprised mainly of female participants, who were recruited from a first year university population. University students were considered an appropriate sample for this research as they form a large proportion of the young driver population and have similar education levels within this university population, a potential confound that could have influenced the ERP findings. However, the current findings are not representative of the general population and future research is required to replicate this design using a more representative sample of young drivers. Potentially, future research may also benefit by recruiting a range of both younger and older road users to examine the message processing and message acceptance of a range of messages more broadly and as a function of various demographic groups.

A further limitation of this research was that it did not control for additional factors (e.g., exposure to other road safety advertisements) that may have potentially influenced participants' responses to the written message stimuli (Study 2) or pictorial stimuli (Study 3). For instance, exposure to road safety messages outside the experimental context may have influenced how young drivers responded on the follow-up questionnaire in Study 2, which assessed behaviour since exposure to the messages. However, to reduce the effect of these potential confounds, data from the participants was not collected over the Christmas and Easter holiday periods, when an increase in media road safety campaigns often occurs and therefore could have potentially influenced participants' responses. Further research should include additional self-report measures to control for such potential confounds.

Given that one of the purposes of this program of research was to examine the underlying BAS and FFFS processes, both Corr and Cooper's RST-PQ and Jackson-5 Scales were used to assess these specific BAS and FFFS components. Corr and Cooper's RST-PQ comprises of four scales to assess the underlying BAS processes (i.e., BAS: Reward Interest, BAS: Goal-Drive Persistence, BAS: Reward Reactivity, and BAS: Impulsivity) and only one scale to assess the whole FFFS construct.[75] The Jackson-5 Scales consists of three scales to examine the underlying processes of the FFFS (i.e., Fight, Flight, and Freeze) and only one overall measure of the BAS. Although it may be argued that including two measures to assess the RST traits could increase the chance of finding significant results, these measures were designed to assess different underlying trait processes and, as such, should not affect the conclusions drawn from this research.

[75] Currently, there is no validated published RST questionnaire available that measures both the underlying BAS and FFFS processes.

Further research would benefit from continuing to examine information processing (via N100, N200, and P300 ERPs) as a function of RST traits. As previously discussed, the RST-based ERP findings have been inconsistent; Gable and Harmon-Jones (2013) found some significant differences in pre-attention (as assessed by the N100) towards positive images, as a function of BAS. While in Study 3b, the findings showed some significant differences in the N200 response towards negative images, as a function of CC BAS: Reward Reactivity and CC BAS: Impulsivity. Alternatively, Balconi et al. (2012) found that BAS/ original BIS traits influenced processing (as assessed by the P300) of positive and negative images, respectively. Further research attention is required to continue the examination of the role of RST traits in earlier attentional and/ or later higher order cognitive processes as assessed by N100, N200, and P300.

Future research could build upon the current program of research by including a combination of both text-based and pictorial stimuli or alternatively, previous televised road safety advertisements within the same study and sample to examine RST trait effects on message processing and subsequent message acceptance. Although the purpose of this research was to assess processing responses towards either written or pictorial stimuli, previous research has reported that using a combination of both written and visual stimuli may be more effective at increasing message persuasiveness, compared to using either approach alone (e.g., Gallopel-Morvan et al., 2011; Kees et al., 2006). For instance, similar to the Kessels et al. (2011) dual-processing ERP task,[76] future research could examine message processing by exposing participants to a previous televised road safety advertisement, while they are also required to respond to auditory cues. It would then be anticipated that individuals who have slower RTs to the auditory stimuli cues would demonstrate greater

[76] Written message stimuli was used in Kessel and colleagues (2011) dual-processing task.

processing of the road safety advertisements than those individuals with faster RTs to the auditory cues (and, it is inferred, less attention towards the road safety advertisements).

Alternatively, similar to Falk et al.'s (2011) research that examined smokers' responses towards anti-smoking campaigns, a functional Magnetic Resonance Imaging (fMRI) study could be designed in which participants view a series of road safety advertisements and their higher order cognitive processes which are involved in processing the messages are assessed simultaneously. For instance, to further examine the influence of RST traits on the relative effectiveness of message framing manipulations, individuals with stronger BAS or stronger FFFS traits could view televised gain-framed/ positive or loss-framed/ negative advertisements, respectively, while neural activity (measured by fMRI) is assessed.

Drawing upon previous research in multisensory perception (e.g., Körding et al., 2007; Shams, Kamitani, & Shimojo, 2000; visual perception may be influenced by audio perception and vice versa), it could be speculated that video advertisements may lead to different BAS and FFFS effects compared to written or pictorial stimuli. For instance, a 30 second video advertisement containing a range of visual, written, and audio cues that elicit fear-based emotions may generate a stronger FFFS response due to the activation of multiple senses than either a written loss-framed message or negative visual image. Thus, it is recommended that future research replicates the current research by incorporating video advertisements.

While it has been stated throughout that personality traits are stable and are unlikely to change, it has been argued by others that traits may be dependent upon the situation (i.e., traits may change in accordance with different environmental situations, Fleeson & Gallagher, 2009). Given that the current program of research included three types of measurements (self-report, behavioural, and psychophysiological) the different contexts provided by these measures may have potentially produced different trait manifestations. For instance, while an individual may have reported higher BAS scores on the self-report RST scale, their performance on the LDT in Study 2 or the Oddball paradigm task in Study 3 might not have been predicted by their stronger self-reported BAS traits. It may be likely then, that the findings were the result of context-dependent effects (i.e., behaviour changes as the result of the context). It has been noted by Flesson and Gallagher (2009) that future research is required to further assess if self-reported traits can predict how an individual acts across multiple behavioural contexts and time points (e.g., retesting across multiple sessions).

9.5 Research contribution

9.5.1 Theoretical implications

The current program of research focused on Gray and McNaughton's (2000) revised RST. While the revisions were made to this theory over 13 years ago, surprisingly there has been a lack of research focused upon these revisions, particularly in the health communication literature. This research extended upon the current RST and health communication research by assessing the BAS and the FFFS components separately to examine the potential effects of these trait components on message processing and subsequent message acceptance. While there were significant moderate positive relationships between some BAS traits and acceptance of the gain-framed messages, effects of other BAS components did not reach significance. Similar relationships were also reported between some of the FFFS traits and acceptance of the loss-framed messages. Thus, these finding not only support previous research which has suggested that the BAS and the FFFS traits consist of various underlying processes (see Carver & White, 1994; Corr & Cooper, 2013), but also highlight the need to further examine these independent components in future RST-based health communication research.

Examining the individual BAS and FFFS processes may enable campaign designs to target specific reward and punishment processes rather than trying to target the whole constructs. For instance, findings from Study 3 revealed that reward reactivity and impulsivity influenced how individuals perceived negative images that were taken from previous road safety campaigns. In contrast, there were no significant effects of reward interest and goal-drive persistence. As discussed in chapter 2 (section 2.4.1), Corr and Cooper (2013) propose that reward interest and goal-drive persistence are earlier approach behaviours which relate to the initial motivation of approaching a reward stimulus, while reward reactivity and impulsivity are later approach behaviours and are involved in the final stages of obtaining the reward. Thus, based on the current findings, it could be speculated that the later approach behaviours may be more relevant in processing health communication messages than the earlier approach behaviours. However, before this finding is translated to message design practice, more research is required to examine the individual RST processes to further understand the role that these BAS and FFFS processes may have on one's processing and acceptance of health messages.

The current findings also provided further empirical evidence to support the theoretical changes made to the revised BIS and FFFS; specifically that anxiety and fear are independent emotional systems. While Gray's original RST combined these two emotional responses, Gray and McNaughton (2000) differentiated between the BIS: Anxiety and FFFS: Fear responses. As discussed in chapter 2, the revised RST postulates that the BIS is activated when individuals are exposed simultaneously to a reward cue (results in activation of the BAS) and to a punishment cue (results in activation of the FFFS). To create goal conflict in Study 2, participants were exposed to two competing BAS/ FFFS stimuli: a motor vehicle message designed to activate the BAS and a social loss-framed message designed to activate the FFFS. Consistent with the theoretical predictions of the revised RST, the BIS was only activated (effect apparent) on presentation of both the social loss-framed message and motor vehicle message. No evidence was found for the activation of the BIS in the message only condition. Thus, from a theoretical perspective, these findings not only suggest that fear and anxiety derive from two independent emotional system, but also highlight the need for researchers to use measures of the revised RST rather than the original RST components.

9.5.2 Methodological implications

Previous RST-based health communication research has tended to rely upon self-report measures of message processing and subsequent message acceptance. However, given that processing occurs in the unconscious (e.g., Chaumon et al., 2008; Kihlstrom, 1987; van Gaal et al., 2010), one could argue that objective based measures are required to assess processing. The current research findings highlight the utility of combining objective measures with measures of self-report to assess message processing and message acceptance, respectively. Incorporating a range of objective and self-report measures may enable researchers to more comprehensively assess message processing and subsequent message acceptance.

To assess the effects of the BAS and the FFFS on message processing, the current program of research used three measurement approaches: self-report assessments to assess message acceptance, behavioural reaction times to message stimuli (LDT), and neural responses to message stimuli (ERPs). The findings from Studies 2 and 3 revealed different effects of the BAS and the FFFS on text-based message processing/ acceptance, depending on which measure was used. For instance, while there were no significant effects of the BAS and the FFFS traits on message processing (assessed via a LDT) there were some significant effects of BAS and FFFS on message acceptance. Further, there were significant effects of the BAS on visual image processing (assessed via ERPs) in Study 3. However, contrary to the theoretical predictions of the BAS, those who reported a stronger BAS in Study 3 showed greater pre-attentional processes towards the negative images. Differences in these findings may be due to the self-report questionnaires measuring traits, which are relatively stable across time, while the behavioural and neurological measures assess states (i.e., moment by moment fluctuations, which are likely to be context dependent). Given that these measurement approaches lead to different RST effects in the current program of research, it is recommended that future research that examines the influence of the BAS and the FFFS on the relative effectiveness of health communication messages, similarly comprises both trait and state measures. Applying different measurement approaches enables a more comprehensive understanding of how the reward and punishment systems influence both message processing, message acceptance, and subsequent behaviour change.

This study was the first to use ERPs to examine message processing in a road safety advertising context. While incorporating psychophysiological measures to further examine health communications messages is a relatively new approach in the field, marketing studies have effectively used these measures to enhance the persuasiveness of products and branding advertisements for some years now (e.g., Ravaja, 2004). The current findings have important implications for how the design of road safety advertisements may be informed by understanding persuasive effects via objective measures. For instance, assessing pre-attentional and higher order cognitive processes of individuals whilst they are viewing road safety messages may enable campaign designers to more effectively create messages to target processing biases of high risk drivers.

9.5.3 Practical implications

This research also has important implications for message design. Consistent with previous research (e.g., Goldenbeld et al., 2008; Kaye et al., 2013; Lewis et al., 2008b, 2009), the current findings suggest that while gain-framed messages may be more effective for some drivers, other drivers may be more persuaded by loss-framed messages. In the current research, stronger BAS individuals reported greater risky driving behaviour that those with weaker BAS traits. Further, there were some significant moderate positive correlations between BAS and message acceptance ratings of the gain-framed messages, suggesting that these higher risk BAS individuals may be more persuaded by reward-focused positive messages than the more traditional threat-based messages. Personality traits are relatively stable and therefore, unlikely to change suggesting that it may be possible to design a range of gain-framed messages to align with BAS traits, to target those individuals shown to be at greatest risk for particular health behavioural outcomes (e.g., BAS and risky driving).

The findings from this program of research also highlighted that motor vehicle advertisements may influence young drivers' acceptance of road safety messages. For instance, in Study 1c the majority of males reported that the motor vehicle message, promoting a high performance vehicle, was persuasive. Further, Study 2 findings suggested that more anxious individuals (i.e., stronger BIS) showed interference with processing of the social loss-framed message when it was presented in conjunction with the motor vehicle message. While the Advertising for Motor Vehicle Voluntary Code of Practice was designed to prevent unsafe and/ or illegal driving behaviours being presented in motor vehicle advertisements, some vehicle advertisements still indirectly promote unsafe driving behaviours (e.g., see Donovan et al., 2011a, 2011b). Thus, more research is required to investigate the potential negative implications that motor vehicle advertisements which imply unsafe driving behaviours may have on acceptance of road safety messages, especially for high risk young male drivers (i.e., those with stronger BAS traits) and individuals with stronger BIS: Anxiety traits.

The current findings also have important implications for persuasion literature. While previous research has reported that male drivers may be more persuaded by gain-framed than loss-framed road safety campaigns (e.g., Lewis et al., 2008b), the findings from Study 2 highlighted that males were more likely to perceive the social loss-framed message to be intended for people like them (than for others) compared to females. Further, group discussions from Study 1c revealed that upon reading the social loss-framed message, male drivers felt a sense of responsibility towards their passengers and acknowledged the negative impact that speeding may have on their family and friends. Collectively, these findings further highlight the need to consider alternative road safety approaches to target those individuals who are at greatest risk such as, male drivers.

Given that young drivers are particularly susceptible to driving related fatalities, it is important to continue to implement targeted prevention strategies, such as road safety messages, to reduce the crash risk of young drivers. In addition to RST effects and gender differences, the findings showed that young drivers in the current sample considered themselves to be less susceptible to the negative consequences associated with risky driving behaviour and perceived themselves to be more skilful, safer on the roads, and more experienced compared to a ‘typical young driver’. These findings highlight that along with creating a range of gain-framed and loss-framed messages to target on road risk taking behaviours, advertisement researchers and practitioners should also consider countering optimism bias through road safety messages (e.g., by emphasizing that all young drivers that participate in risky driving behaviours are susceptible to road crashes and associated injuries).

9.6 Chapter Summary

The purpose of this research program was to provide an original contribution to knowledge by incorporating objective measures to examine the extent to which individual differences in the revised RST traits influenced individuals’ processing and subsequent acceptance of health communication messages. Previous research in the health communication field that had examined the relative effectiveness of gain-framed and loss-framed messages, as a function of RST, had relied upon Gray’s original definition of the BAS and BIS traits (e.g. Mann et al., 2004). Further, previous research typically relied upon self-report measures to examine message processing (e.g., Shen & Dillard, 2007). The current research was unique in its approach of incorporating more objective measures to further examine message processing. This research also extended upon previous research studies in the health communication field by examining the effects of the individual BAS and FFFS components on message processing and acceptance in a road safety advertising context, as well as the influence of the BIS in individuals' processing of conflicting message cues (i.e., road safety message versus promotional motor vehicle message).

Health communication messages are designed to improve the quality and longevity of individuals' lives and have long been considered an effective countermeasure to encourage individuals to adopt healthier attitudes and behaviours. However, for such messages to persuade, they need to be designed to appeal to their target audience. While previous research has examined a large number of factors which may potentially influence the persuasiveness of health communication messages, one area which has received limited research attention is the influence that personality traits may have on message persuasion effects.

As argued throughout this dissertation, considering individual differences in BAS and FFFS traits when designing health campaigns and more specifically, road safety messages may be one approach to increase message persuasiveness and in turn, reduce risky behaviours. Given that road-related injuries are a leading cause of death (WHO, 2013), there is a need to identify effective countermeasures so as to encourage high risk road users to adopt safer driving attitudes and behaviours. Targeting individuals through public education and advertising campaigns represents a long-standing approach within the array of road safety countermeasures implemented in the attempt to reduce road trauma. While historically, many of these campaigns have relied upon physical threat-based appeals aimed at evoking strong levels of fear, positive approaches (e.g., gain-framed messages) may represent a potentially effective alternative for persuading high risk road user groups. The current program of research represents a significant contribution to the identification of key individual characteristics likely to influence message processing and subsequent message acceptance of road safety advertising countermeasures. This evidence provides important insights which campaign designers may draw upon to aid in the development of future public education campaigns. Such campaigns may persuade individuals to reduce their engagement in risky on-road behaviours which will, ultimately, contribute to reductions in road trauma.

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Appendices

Appendix A

Semi-Structured Interview Guide

1. What do you think about current road safety campaigns?
2. What messages do you remember about these campaigns? Why?
3. Did these messages influence your own behaviour? Why/ Why not?
4. Do you think that these messages would influence others? Why/ Why not?

For each road safety message (i.e., physical gain, physical loss, social gain and social loss):

5. What are your first impressions of this message?
6. How does this message make you feel/ think?
7. Do you think that this message would influence your own behaviour?
8. Do you think that this message would influence others?
9. How long would this messages influence your own behaviour?
10. Do you have any other comments or opinions that you would like to share about this message?

After viewing all four road safety messages:

11. Of the four road safety messages, which message(s) would you find most effective?

Motor vehicle advertisement:

12. What are your first impressions of this advertisement?
13. How does this advertisement make you feel/ think?
14. Who do you think this advertisement was designed for?
15. Do you have any other comments or opinions that you would like to share about this advertisement?

Provide a brief overview of what was discussed

16. Does this summary cover what was discussed today?
17. Is there anything regarding the road safety messages that we should have talked about but didn't?

Appendix B

Questionnaire Order Effects: Study 2

Table B.1

Personality Scale Questionnaire Order Effects: Demographic Variables (Age and Gender)

Variable	*M (SD)*	*t*	*p*	CI
Gender				
Questionnaire order 1	1.69 (0.49)			
Questionnaire order 2	1.65 (0.49)	0.40	.689	-0.18, 0.27
Questionnaire order 1				
Questionnaire order 3	1.82 (0.39)	-1.48	.142	-0.30, 0.04
Questionnaire order 2				
Questionnaire order 3		-1.82	0.71	-0.36, 0.15
Age				
Questionnaire order 1	20.21 (2.54)			
Questionnaire order 2	19.73 (2.25)	0.82	.413	-0.67, 1.62
Questionnaire order 1				
Questionnaire order 3	19.81 (2.61)	0.77	.446	-0.63, 1.43
Questionnaire order 2				
Questionnaire order 3		-0.14	.891	-1.17, 1.02

Note. Questionnaire 1 order = Carver and White's BIS/ BAS Scales, Jackson-5 Scales, and Corr and Cooper's RST-PQ. Questionnaire 2 order = Corr and Cooper's RST-PQ, Carver and White's BIS/ BAS Scales. Questionnaire 3 order = Jackson-5, Corr and Cooper's RST-PQ, and Carver and White's BIS/ BAS Scale. CI = Confidence Interval

Table B.2

Personality Scale Questionnaire Order Effects: Self-reported Speeding Behaviour

Variable	*M (SD)*	*t*	*p*	CI
Speeding behaviour				
Questionnaire order 1	1.74 (0.45)			
Questionnaire order 2	1.65 (0.49)	0.85	.399	-0.13, 0.31
Questionnaire order 1				
Questionnaire order 3	1.55 (0.50)	1.95	.054	-0.01, 0.38
Questionnaire order 2				
Questionnaire order 3		0.89	.389	-0.12, 0.31

Note. Questionnaire 1 order = Carver and White's BIS/ BAS Scales, Jackson-5 Scales, and Corr and Cooper's RST-PQ. Questionnaire 2 order = Corr and Cooper's RST-PQ, Carver and White's BIS/ BAS Scales. Questionnaire 3 order = Jackson-5, Corr and Cooper's RST-PQ, and Carver and White's BIS/ BAS Scale. CI = Confidence Interval

Appendix C

CARROT and Q-Task findings

Gain-framed message effects

H.1. Individuals with a stronger BAS would demonstrate a greater cognitive bias towards the content presented via the gain-framed messages, compared to individuals with a weaker BAS. Further, these individuals would be more likely to accept these messages (as measured by subsequent ratings of message effectiveness, attitudes, behavioural intentions, and message compliance).

Bivariate correlations/ mediations. There was a significant moderate negative relationship between the CARROT scores and RT to the words in the social gain-framed message for those exposed to that message condition (see Table B.1). However, considering similar relationships were also found for those participants between the CARROT scores and RT to the words in the physical message (r = -.408, p = .035) and between CARROT scores and RT to the words in the motor vehicle message (r = .411, p = .037), it was suspected that this relationship did not infer greater processing of the social gain-framed message and instead, may be the result of an approach effect (i.e., stronger BAS individuals showing faster RTs to all word stimuli, regardless of prior exposure). There were no additional significant relationships between the CARROT and message processing nor between the CARROT and message acceptance for the social and physical message conditions (see Table C.1). There were also no significant mediations (see Tables C.2 and C.3).

Table C.1

Bivariate Correlations between the CARROT and Message Processing and the CARROT and Message Acceptance for Participants who viewed the Gain-framed messages

	Processing (RT)	Message effectiveness	Attitudes	Behavioural intentions	Message compliance
Physical gain-framed message					
CARROT	-.071	.026	.013	.014	-.349
Social gain-framed message					
CARROT	-.409*	-.061	.006	-.003	-.095

* $p < .05$

Table C.2

Mediation Statistics: CARROT and Physical Gain-framed Message on Message Acceptance

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CARROT-RT-effectiveness				
a (CARROT-RT)	-1.17	3.30	-7.97, 5.63	.726
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.664
ć (CARROT-effectiveness)	-0.06	0.07	-0.21, 0.09	.427
ab	< 0.01	0.02	-0.02, 0.05	> .05
CARROT-RT- attitudes				
a (CARROT-RT)	-1.17	3.30	-7.97, 5.63	.726
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.713
ć (CARROT- attitudes)	0.01	0.04	-0.06, 0.09	.769
ab	< 0.01	0.01	-0.01, 0.03	> .05
CARROT-RT- intentions				
a (CARROT-RT)	-1.17	3.30	-7.97, 5.63	.726
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.739
ć (CARROT- intentions)	0.04	0.05	-0.06, 0.13	.466
ab	< 0.01	0.01	-0.01, 0.03	> .05
CARROT-RT- compliance				
a (CARROT-RT)	-1.14	3.46	-8.31, 6.02	.744
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.674
ć (CARROT- compliance)	-0.01	0.05	-0.13, 0.09	.736
ab	< 0.01	0.01	-0.02, 0.04	> .05

Table C.3

Mediation Statistics: CARROT and Social Gain-framed Message on Message Acceptance

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CARROT-RT-effectiveness				
a (CARROT-RT)	-5.71	2.55	-10.96, -0.46	.034
b (RT-effectiveness)	< 0.01	0.01	-0.01, 0.01	.686
ć (CARROT-effectiveness)	0.01	0.08	-0.15, 0.17	.901
ab	0.01	0.03	-0.03, 0.09	> .05
CARROT-RT- attitudes				
a (CARROT-RT)	-5.71	2.55	-10.96, -0.46	.034
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.975
ć (CARROT- attitudes)	-0.02	0.05	-0.12, 0.09	.761
ab	< 0.01	0.01	-0.03, 0.03	> .05
CARROT-RT- intentions				
a (CARROT-RT)	-5.71	2.55	-10.96, -0.46	.034
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.819
ć (CARROT- intentions)	0.01	0.05	-0.08, 0.10	.879
ab	< 0.01	0.02	-0.03, 0.04	> .05
CARROT-RT- compliance				
a (CARROT-RT)	-6.99	3.06	-13.55, -0.43	.039
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.00	.131
ć (CARROT- compliance)	0.01	0.05	-0.08, 0.10	.764
ab	0.03	0.03	-0.02, 0.11	> .05

Loss-framed message effects

H.2. Individuals with a stronger FFFS (compared to those with a weaker FFFS) would demonstrate a greater cognitive bias towards the content presented via the loss-framed messages. It was further predicted that greater processing bias would predict greater acceptance and compliance for that message frame.

Bivariate correlations/ mediations. The results indicated moderate positive relationships between the Q-Task avoidance scores and RT to the words in the physical message, which approached significance, $p = 0.91$ (see Table C.4). However, the direction of this relationship was inconsistent with expectations as the positive direction indicated less processing (slower RT) of the physical loss message by those with greater punishment/ inhibition sensitivity (Q-Task). There was also a significant moderate positive relationship between the Q-Task score and RT to the words in the social loss-framed message, although these results were similarly not in the predicted direction (i.e., higher Q-Task/ FFFS scores were associated with less processing of these message words). All remaining correlations between the Q-Task, processing, and message acceptance were weak and failed to reach significance. There were also no significant mediations (see Tables C.5 and C.6).

Table C.4

Bivariate Correlations between the Q-TASK and Message Processing and the Q-Task and Message Acceptance for Participants who viewed the Loss-framed messages

	Processing (RT)	Message effectiveness	Attitudes	Behavioural intentions	Message compliance
Physical loss-framed message					
Q-Task	.345	-.047	.054	-.074	.083
Social loss-framed message					
Q-Task	.393*	.191	.018	.036	-.049

* $p < .05$

Table C.5

Mediation Statistics: Q-Task and Physical Loss-framed Message on Message Acceptance

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Q-Task-RT-effectiveness				
a (Q-Task-RT)	0.64	0.40	-0.18, 1.46	.119
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.978
ć (Q-Task-effectiveness)	< 0.01	0.01	-0.02, 0.02	.832
ab	< 0.01	< 0.01	-0.01, 0.01	> .05
Q-Task-RT- attitudes				
a (Q-Task-RT)	0.64	0.40	-0.18, 1.46	.119
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.416
ć (Q-Task- attitudes)	< 0.01	0.01	-0.01, 0.02	.690
ab	< 0.01	< 0.01	-0.01, 0.00	> .05
Q-Task-RT- intentions				
a (Q-Task-RT)	0.64	0.40	-0.18, 1.46	.119
b (RT- intentions)	< 0.01	< 0.01	-0.11, 0.01	.993
ć (Q-Task- intentions)	< 0.01	0.01	-0.02, 0.01	.709
ab	< 0.01	< 0.01	0.00, 0.00	> .05
Q-Task-RT-compliance				
a (Q-Task-RT)	0.64	0.50	-0.42, 1.69	.222
b (RT-compliance)	< 0.01	< 0.01	-0.01, 0.01	.864
ć (Q-Task-compliance)	< 0.01	0.01	-0.02, 0.01	.961
ab	< 0.01	< 0.01	-0.01, 0.00	> .05

Table C.6

Mediation Statistics: Q-Task and Social Loss-framed Message on Message Acceptance

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Q-Task-RT-effectiveness				
a (Q-Task-RT)	-0.75	0.29	-1.34, -0.17	.014
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.429
ć (Q-Task-effectiveness)	< 0.01	0.01	-0.01, 0.01	.928
ab	< 0.01	< 0.01	-0.01, 0.01	> .05
Q-Task-RT- attitudes				
a (Q-Task-RT)	-0.75	0.29	-1.34, -0.17	.014
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.528
ć (Q-Task- attitudes)	< 0.01	0.01	-0.01, 0.01	.795
ab	< 0.01	< 0.01	0.00, 0.01	> .05
Q-Task-RT- intentions				
a (Q-Task-RT)	-0.75	0.29	-1.34, -0.17	.014
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.638
ć (Q-Task- intentions)	< 0.01	< 0.01	-0.01, 0.01	.524
ab	< 0.01	< 0.01	0.00, 0.01	> .05
Q-Task-RT-compliance				
a (Q-Task-RT)	-0.63	0.29	-1.24, -0.03	.040
b (RT-compliance)	< 0.01	< 0.01	-0.01, -0.01	.470
ć (Q-Task-compliance)	< 0.01	0.01	-0.01, 0.01	.997
ab	< 0.01	< 0.01	-0.01, 0.00	> .05

Message framing effects (physical vs. social message condition)

H.3. Stronger BAS would predict greater processing, acceptance, and compliance of the physical gain-framed message compared to the physical loss-framed message. Similarly, it was anticipated that individuals with a stronger FFFS would show greater processing, acceptance, and compliance of the physical loss-framed message than the physical gain-framed message. Further, it was hypothesised that these expected findings would be replicated for the social gain-framed and loss-framed messages, respectively.

CARROT scores and framing on message compliance. There was a significant main effect of the CARROT scores, $F(1, 53) = 5.20$, $p = .030$, $\eta_p^2 = .148$, with the simple slopes showing that higher CARROT scores were associated with lower self-reported message compliance (see Figure C.1), regardless of message frame. There were no significant main effects of framing or CARROT x framing interaction, $F(1,53) = 0.12$, $p = .748$, $\eta_p^2 = .004$.

Q-Task and framing on processing. There was a significant main effect of the Q-Task scores, $F(1, 50) = 4.19$, $p = .046$, $\eta_p^2 = .080$, with the simple slopes showing that higher Q-Task scores were associated with less processing of the words from the social messages (see Figure C.2), regardless of message frame. There were no significant main effects of framing, $F(1, 50) = 0.14$, $p = .711$, $\eta_p^2 = .003$ or Q-Task x framing interaction, $F(1, 50) = 0.26$, $p = .613$, $\eta_p^2 = .005$.

The results also revealed that the CARROT x framing interaction on processing of the social message was approaching significance, $F(1,53) = 3.53$, $p = .066$, $\eta_p^2 = .066$. However, there were no additional significant CARROT effects on message processing or message acceptance (see Tables C.7 and C.8) or significant Q-Task effects on message processing or message acceptance (see Tables C.9 and C.10).

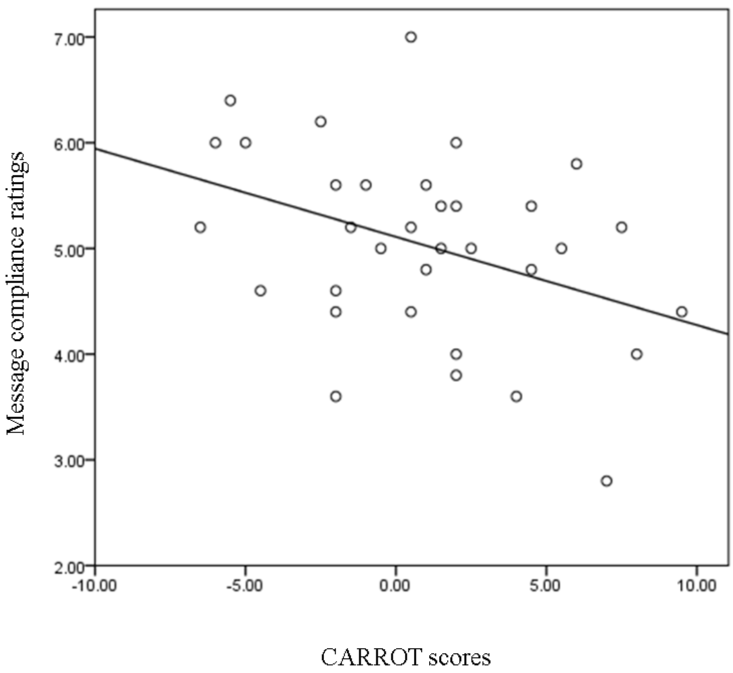

Figure C.1. Partial correlation of CARROT scores and message compliance ratings for the physical messages.

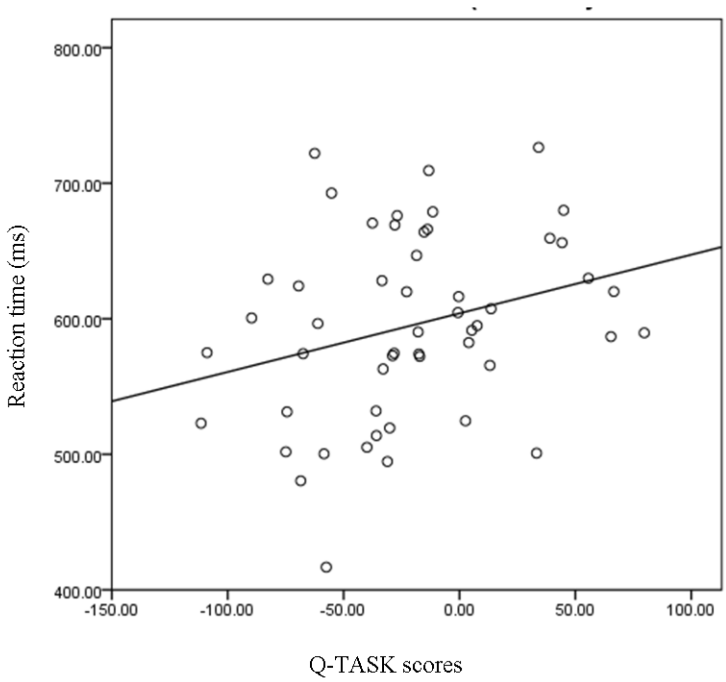

Figure C.2. Partial correlation of Q-Task scores and processing for the social messages.

Table C.7

Non-Significant ANOVA Effects of the CARROT and Framing (Gain-framed vs. Loss-framed) on Message Processing (RT) and Message Acceptance for the Physical Message Conditions

Effect	*F*	*p*	η_p^2
CARROT and framing on processing			
CARROT	< 0.01	.947	< .001
framing	0.27	.609	.005
CARROT x framing	0.36	.551	.007
CARROT and framing on message effectiveness			
CARROT	1.01	.319	.020
framing	0.78	.381	.015
CARROT x framing	1.47	.231	.029
CARROT and framing on attitudes			
CARROT	1.15	.289	.022
framing	0.02	.887	< .001
CARROT x framing	1.39	.244	.027
CARROT and framing on behavioural intentions			
CARROT	0.07	.793	.001
framing	0.22	.634	.004
CARROT x framing	0.14	.712	.003

Table C.8

Non-Significant ANOVA Effects of the CARROT and Framing (Gain-framed vs. Loss-framed) on Message Processing (RT) and Message Acceptance for the Social Message Conditions

Effect	*F*	*p*	η_p^2
CARROT and framing on message effectiveness (*n* = 54)			
CARROT	0.92	.342	.018
framing	0.13	.720	.003
CARROT x framing	0.34	.563	.007
CARROT and framing on attitudes (*n* = 54)			
CARROT	0.13	.726	.002
framing	0.03	.870	.001
CARROT x framing	0.10	.750	.002
CARROT and framing on behavioural intentions (*n* = 54)			
CARROT	< 0.01	.981	< .021
framing	0.14	.712	.003
CARROT x framing	< 0.01	.966	< .011
CARROT and framing on message compliance (*n* = 35)			
CARROT	0.67	.418	.021
framing	0.88	.356	.028
CARROT x framing	0.14	.711	.004

Table C.9

Non-Significant ANOVA Effects of the Q-Task and Framing (Gain-framed vs. Loss-framed) on Message Processing (RT) and Message Acceptance for the Physical Message Conditions

Effect	*F*	*p*	η_p^2
Q-Task and framing on processing (*n* = 50)			
Q-Task	1.52	.244	.032
framing	0.03	.868	.001
Q-Task x framing	1.76	.191	.037
Q-Task and framing on message effectiveness (*n* = 50)			
Q-Task	2.23	.152	.044
framing	1.30	.260	.028
Q-Task x framing	1.24	.271	.026
Q-Task and framing on attitudes (*n* = 50)			
Q-Task	0.01	.912	< .001
framing	0.09	.763	.002
Q-Task x framing	0.21	.646	.005
Q-Task and framing on behavioural intentions (*n* = 50)			
Q-Task	0.44	.511	.009
framing	0.35	.558	.008
Q-Task x framing	0.01	.909	< .001
Q-Task and framing on message compliance (*n* = 31)			
Q-Task	0.59	.448	.021
framing	0.02	.878	.001
Q-Task x framing	1.33	.259	.047

Table C.10

Non-Significant ANOVA Effects of the Q-Task and Framing (Gain-framed vs. Loss-framed) on Message Processing (RT) and Message Acceptance for the Social Message Conditions (n = 52)

Effect	*F*	*p*	η_p^2
Q-Task and framing on message effectiveness			
Q-Task	0.02	.901	< .001
framing	0.65	.423	.013
Q-Task x framing	1.48	.230	.030
Q-Task and framing on attitudes			
Q-Task	1.44	.236	.029
framing	0.56	.460	.011
Q-Task x framing	1.75	.192	.035
Q-Task and framing on behavioural intentions			
Q-Task	1.49	.229	.030
framing	1.62	.210	.033
Q-Task x framing	2.02	.162	.040
Q-Task and framing on message compliance			
Q-Task	0.15	.705	.005
framing	0.12	.736	.004
Q-Task x framing	0.40	.540	.013

BIS (as measured by the Q-Task)[77] and processing of the mixed message cues

H.4a. Individuals with a stronger BIS (compared to those individuals with a weaker BIS) would inhibit their responses, as demonstrated by slower RTs to the words from these message stimuli (i.e., social-loss and motor vehicle message).

H.4b. Individuals with a stronger BIS would respond slower to words from the loss-framed message compared to their counterparts who were only exposed to the social loss-framed message.

H.4c. Individuals with a stronger FFFS (compared to those with a weaker FFFS) would report greater acceptance of the social loss-framed message. Similarly, it was expected that individuals with a stronger BAS in this condition would show greater acceptance of the vehicle message than those individuals with a weaker BAS.

Bivariate correlations. There was a moderate positive relationship between the Q-Task scores and processing of the social words for participants exposed to the mixed condition, which failed to reach significance, $r = .330$, $p = .107$. There was no significant relationship between the Q-Task scores and processing of the words in the motor vehicle message for these participants, $r = .148$, $p = .481$.

A series of ANOVAs were then undertaken in which condition (i.e., social loss-framed message only versus mixed cue condition, which comprised both the social loss-framed message plus motor vehicle message) was entered as the IV, the Q-Task was entered separately as the CVs, and RT to the message words and message acceptance measures were entered separately as the DVs in each analysis.

Q-Task scores and condition on processing. There was a significant main effect of Q-Task, $F(1, 50) = 6.81$, $p = .012$, $\eta_p^2 = .126$, with the simple slopes graph revealing that

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[77] Given that the CARROT scores showed significant moderate positive correlations with BIS scores (as measured by Carver and White and Corr and Cooper), the CARROT data were included in the main data analyses to explore if there were any significant effects of the CARROT in the mixed cue condition.

once again, higher Q-Task scores were associated with slower RTs of the words in the social message (see Figure C.3), regardless of message condition (i.e., social loss-framed and mixed cue condition). There were no significant main effects of condition or Q-Task x condition interaction, $F(1,50) = 0.01$, $p = .981$, $\eta_p^2 < .001$.

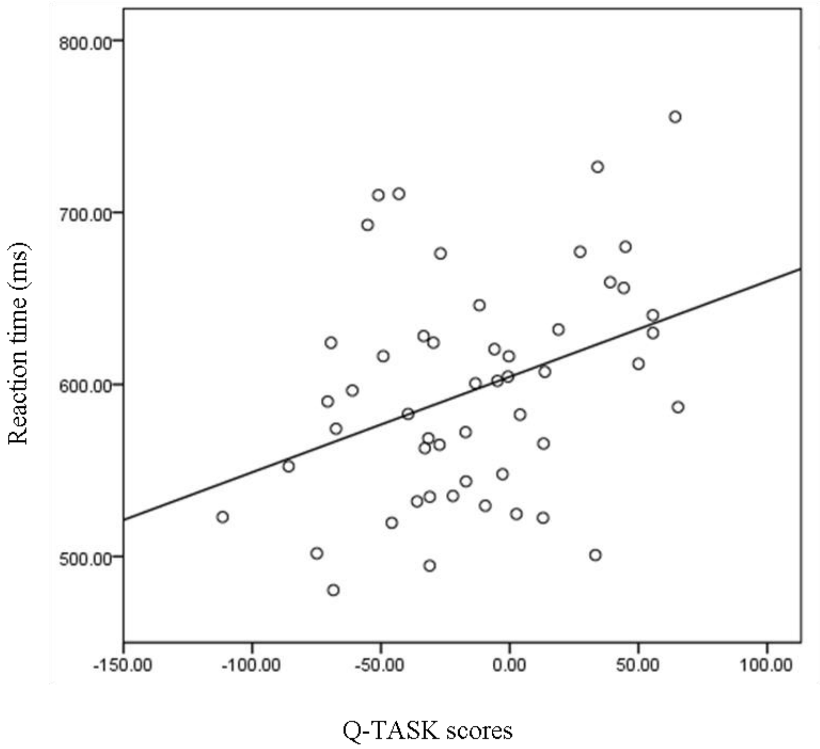


Figure C.3. Partial correlation of the Q-Task scores and message processing.

Q-Task, condition, and gender on message compliance.[78] While there were no significant main effects of Q-Task, $F(1, 36) = 0.37$, $p = .548$, $\eta_p^2 = .013$, or condition, $F(1, 36) = 0.39$, $p = .536$, $\eta_p^2 = .013$, there was a significant main effect of gender, $F(1,36) = 11.33$, $p = .002$, $\eta_p^2 = .281$, indicating that females ($M = 5.76$, $SD = 0.82$) reported greater message compliance than males ($M = 4.96$, $SD = 1.42$). Given that there was also a significant Q-TASK x condition x gender interaction, $F(1, 36) = 3.02$, $p = .046$, $\eta_p^2 = .238$,

[78] Since the preliminarily findings revealed that female drivers were more likely to report complying with the social loss-frame message than male drivers, Gender was entered in as an additional CV in all analyses that examined the social loss-frame message and message compliance in the mixed cue condition to control for differences in gender that may influence the results.

two-way follow-up were performed separately for males and females. For males, there was no significant Q-TASK x condition interaction, $F(1, 10) = 0.11$, $p = .753$, $\eta_p^2 = .015$. Similarly, there was no significant Q-TASK x condition interaction for the females, $F(1, 24) = 0.03$, $p = .875$, $\eta_p^2 = .001$. There were no additional significant effects of the Q-TASK on message processing or message acceptance for those individuals in the mixed cue condition (see Table C.11).

Table C.11

Non-Significant ANOVA Effects of the Q-Task and Condition (Social Loss-framed vs. Mixed Messages) on Message Acceptance (n = 51)

Effect		F	p	η_p^2
Q-Task and framing on message effectiveness				
	Q-Task	0.82	.370	.017
	framing	0.85	.361	.018
	Q-Task x framing	< 0.01	.976	< .001
Q-Task and framing on attitudes				
	Q-Task	0.28	.599	.006
	framing	0.14	.707	.003
	Q-Task x framing	0.18	.673	.004
Q-Task and framing on behavioural intentions				
	Q-Task	0.33	.569	.007
	framing	0.17	.684	.004
	Q-Task x framing	0.14	.706	.003

Appendix D

Study 2 findings: Carver and White BIS/ BAS Scales

Hypothesis 1: Gain-framed message effects

H.1. Individuals with a stronger BAS would demonstrate a greater cognitive bias towards the content presented via the gain-framed messages, compared to individuals with a weaker BAS. Further, these individuals would be more likely to accept these messages (as measured by subsequent ratings of message effectiveness, attitudes, behavioural intentions, and message compliance).

Physical gain-framed message. There were two significant moderate positive relationships between CW BAS traits and message acceptance measures for participants in this condition (see Table D.1). There was a significant moderate positive relationship between CW BAS: Reward Responsiveness and behavioural intentions, indicating that individuals with higher reward responsiveness ratings showed higher intentions to comply with the physical gain-framed message. Further, CW BAS: Fun Seeking scale showed a moderate significant positive relationship with message effectiveness, indicating that individuals high on BAS: Fun Seeking were more likely to rate the physical gain-framed message as more effective. While not significant, there were trend level ($p < .1$) moderate positive correlations in the expected direction between CW BAS: Fun Seeking and attitudes, $p = .093$, and between CW BAS: Fun Seeking and message compliance, $p = .063$.

Social gain-framed message. There was a significant moderate positive relationship between CW BAS: Reward Responsiveness and message compliance, indicating that those individuals with higher BAS: Reward Responsiveness scores were subsequently more compliant with the social gain-framed message. In contrast, there was a significant strong negative correlation between CW BAS: Fun Seeking and message compliance, suggesting those high on this trait were less likely compliant with the social gain-framed message (see Table D.1).

Table D.1

Bivariate Correlations between CW BAS/ FFFS Traits and Message Processing and CW BAS/ FFFS Traits and Message Acceptance for Participants who viewed the Physical and Social Gain-framed and Loss-framed Messages

BAS Subscales	Processing (RT)	Message effectiveness	Attitudes	Behavioural intentions	Message compliance
Physical gain-framed message					
CW BAS: Reward Responsiveness	-.056	.210	.204	.382*	.135
CW BAS: Drive	-.185	-.173	-.189	-.016	.271
CW BAS: Fun Seeking	.248	.404*	.330	.295	.475
Social gain-framed message					
CW BAS: Reward Responsiveness	.266	-.025	.175	.161	.452
CW BAS: Drive	-.121	.050	.088	.151	.274
CW BAS: Fun Seeking	.243	-.061	.094	-.118	-.555*
Physical loss-framed message					
CW FFFS: Fear	-.056	.155	.272	.305	.312
Social loss-framed message					
CW FFFS: Fear	-.004	-.136	.075	.049	.052

Note. CW = Carver and White BIS/ BAS Scales
* $p < .05$

Hypothesis 2: Loss-framed messages effects

H.2. Individuals with a stronger FFFS (compared to those with a weaker FFFS) would demonstrate a greater cognitive bias towards the content presented via the loss-framed messages. It was further predicted that greater processing bias would predict greater acceptance and compliance for that message frame.

Physical and social loss-framed messages. There were no significant relationships between CW FFFS: Fear and message processing or message acceptance for the physical and social loss-framed message conditions. However, while not significant, there was a moderate positive relationship in the predicted direction between CW FFFS: Fear and message compliance for the physical loss-framed message condition, $p = .105$ (see Table D.1).

Hypothesis 3: Message framing effects (i.e., physical condition and social condition)

H.3. Stronger BAS would predict greater processing, acceptance, and compliance of the physical gain-framed message compared to the physical loss-framed message. Similarly, it was anticipated that individuals with a stronger FFFS would show greater processing, acceptance, and compliance of the physical loss-framed message than the physical gain-framed message. Further, it was hypothesised that these expected findings would be replicated for the social gain-framed and loss-framed messages, respectively.

Physical condition. For the physical condition, the ANOVA found no significant main effects and/ or interactions involving Carver and White's RST traits. However, CW BAS: Fun Seeking and CW BAS: Reward Responsiveness main effects approached significance, with medium effect sizes. Further, CW BAS: Fun Seeking x framing interactions on processing and message effectiveness approached significance, with medium effect sizes (see Table D.2). While it is acknowledged that these interactions findings were not significant, the simple slope graphs indicated that the direction of these trend relationships were in line with RST-based expectations (i.e., higher BAS scores tended to lead to higher processing or message effectiveness ratings of the physical gain-framed message).

Table D.2

ANOVA Trend Effects (p < .1) of CW BAS Traits and Framing (Gain vs. Loss) on Message Processing (RT) and Message Acceptance for the Physical and Social Message Conditions

Effect	*F*	*p*	η_p^2
Physical message condition			
CW BAS: Fun Seeking and framing on processing (*n* = 54)			
Fun Seeking	0.04	.836	.061
framing	2.78	.102	.053
Fun Seeking x framing	3.28	.076	.061
CW BAS: Fun Seeking and framing on message effectiveness (*n* = 54)			
Fun Seeking	1.00	.322	.020
framing	3.05	.087	.058
Fun Seeking x framing	3.13	.083	.059
CW BAS: Fun Seeking and framing on message compliance (*n* = 34)			
Fun Seeking	3.40	.075	.102
framing	0.85	.363	.028
Fun Seeking x framing	1.50	.232	.047
Social message condition			
CW BAS: Reward Responsiveness and framing on message compliance (*n* = 53)			
Reward Responsiveness	2.89	.099	.088
framing	1.18	.286	.038
Reward Responsiveness x framing	0.99	.327	.032
CW BAS: Drive and framing on message compliance (*n* = 34)			
Drive	3.13	.087	.094
framing	<0.01	.952	<.001
Drive x framing	0.12	.749	.003

Note. CW = Carver and White's BIS/ BAS Scales

Social condition. For the social condition, the ANOVA findings revealed no significant main effects and/ or interactions involving Carver and White's RST traits. However, the findings did reveal that the main effects of CW BAS: Reward Responsiveness and CW BAS: Drive approached significance, in the expected directions, with medium effect sizes (see Table D.2).

Hypothesis 4: BIS and processing of the mixed message cues.

H.4a. Individuals with a stronger BIS (compared to those individuals with a weaker BIS) would inhibit their responses, as demonstrated by slower RTs to the words from these message stimuli (i.e., social-loss and motor vehicle message).

H.4b. Individuals with a stronger BIS would respond slower to words from the loss-framed message compared to their counterparts who were only exposed to the social loss-framed message.

For individuals exposed to both the social loss-framed and motor vehicle message, there was a significant moderate positive relationship between CW BIS: Anxiety scores and message word processing, $r = .471$, $p = .017$. That is, individuals with a stronger BIS showed inhibition/ avoidance (i.e., as indicated by slower RTs) to the words in the social loss-framed message when that message had been presented concurrently with the vehicle message. Further, there were moderate positive relationships between CW BIS Scale scores and processing of the social words, which failed to reach significance, $r = .305$, $p = .139$.

A series of ANOVAs were then undertaken in which condition (i.e., social loss-framed message only versus mixed cue condition, which comprised both the social loss-framed message plus motor vehicle message) was entered as the IV, the RST traits were each entered separately as the CVs, and RT to the message words was entered separately as the DVs in each analysis. For Carver and White's BIS: Anxiety, while there was a significant main effect of condition, $F(1, 51) = 4.49$, $p = .039$, $\eta_p^2 = .085$, there was no significant main effect of CW BIS: Anxiety, $F(1, 51) = 2.19$, $p = .145$, $\eta_p^2 = .044$. There was, however, a significant CW BIS: Anxiety x condition interaction, $F(1,51) = 5.09$, $p = .029$, $\eta_p^2 = .096$. The partial correlation was significant between CW BIS: Anxiety and message processing for those individuals in the mixed cue condition, $r = .471$, $p = .017$, accounting for 22.2% of the variance. As expected and shown in the simple slopes graph below, individuals with higher BIS scores demonstrated slower RTs (i.e., avoidance/ inhibition) of the words from the message when exposed to both the social loss-framed message and motor vehicle message (see Figure D.1). There was no significant partial correlation of CW BIS: Anxiety and processing when individuals were exposed only to the social loss-framed message, $r = .045$, $p = .808$.

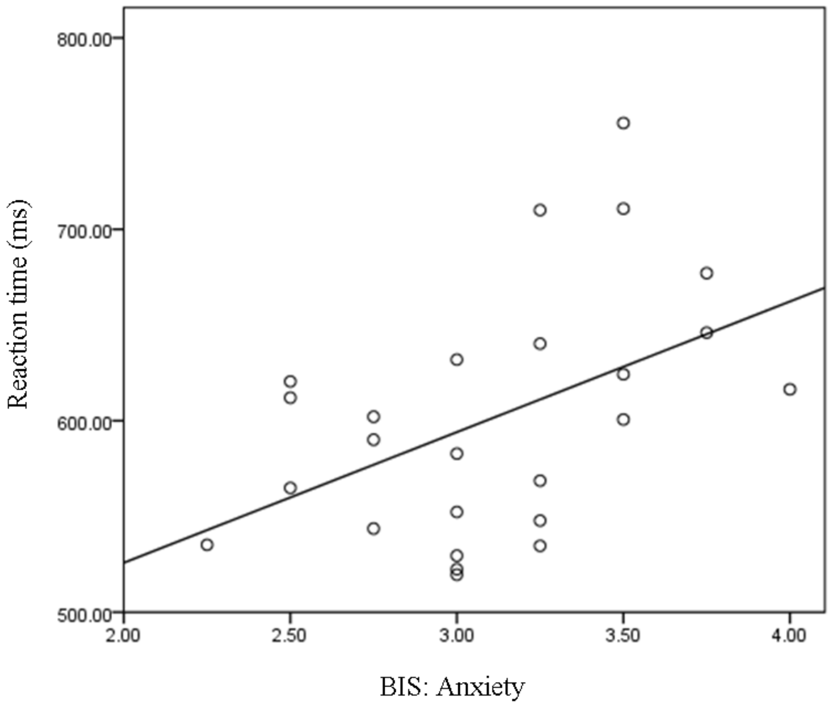


Figure D.1. Partial correlation between CW BIS: Anxiety and RTs to words presented in the social loss-framed message for individuals exposed to the mixed message condition.

H.4c. Individuals with a stronger FFFS (compared to those with a weaker FFFS) would report greater acceptance of the social loss-framed message. Similarly, it was expected that individuals with a stronger BAS in this condition would show greater acceptance of the vehicle message than those individuals with a weaker BAS.

Social loss-framed message. For individuals exposed to the social loss-framed message and motor vehicle message, the moderate positive correlation between CW BIS: Anxiety scores and message effectiveness approached significance, $p = .054$ (see Table D.3). Further, there were also moderate positive correlations between CW BIS: Anxiety and message compliance, between CW BIS and message compliance, and between CW BIS and message effectiveness, although these relationships failed to reach significance, $p > .10$ (see Table D.3).

Motor vehicle message. For the BAS traits, there was a moderate positive correlation between CW BAS: Drive and effectiveness of the vehicle message, however this correlation also failed to reach significance, $p = .130$. There was also a significant moderate positive relationship between CW BAS: Drive and attitudes towards the vehicle message, such that those individuals with higher Drive scores in this trait were more likely to report more favourable attitudes towards this message, as anticipated. However, inconsistent with expectations, no other Carver and White's BAS traits showed a significant relationship with the vehicle acceptance measures.

Table D.3

Bivariate Correlations between CW BAS/ BIS Scales, Processing, and Acceptance for Participants Exposed to the Mixed Condition

	RS message Effective	RS message attitudes	RS message Intentions	RS message compliance	MV message Effective	MV message attitudes	MV message goals
BAS traits							
CW BAS: Reward Responsiveness	.298	.079	-.069	.048	-.031	.272	-.099
CW BAS: Drive	.311	.037	-.115	-.082	.211	.407*	-.038
CW BAS: Fun Seeking	-.040	-.110	-.163	-.121	-.154	-.006	.002
BIS/ FFFS traits							
CW BIS	.296	.287	.311	.324	-.062	-.035	-.257
CW BIS: Anxiety	.390	.247	.269	.300	-.179	-.125	-.358
CW FFFS: Fear	.137	.254	.279	.297	.053	.047	-.118

Note. RS = road safety. MV = motor vehicle. CW = Carver and White BIS/ BAS Scales

* $p < .05$

To further assess the influence of the BIS a series of ANOVAs were then undertaken in which condition (i.e., social loss-framed message vs. mixed cue condition) was entered as the IV, the RST traits were each entered separately as the CVs, and message acceptance was entered separately as the DVs in each analysis.

CW BIS: Anxiety and condition on message effectiveness. There was no significant main effect of BIS: Anxiety, $F(1, 51) = 2.78$, $p = .102$, $\eta_p^2 = .055$, although there was a significant BIS: Anxiety x condition interaction, $F(1, 51) = 4.58$, $p = .037$, $\eta_p^2 = .087$. The partial correlation approached significance between BIS: Anxiety and message effectiveness for those individuals exposed to the mixed message condition, $r = .390$, $p = .054$, with BIS: Anxiety accounting for 15.2% of the variance in message effectiveness. The simple slopes graph for the mixed condition (Figure D.2) showed that the direction of means are consistent with the Jackson's BIS and message effectiveness findings (see Chapter 7). The partial correlation was not significant between BIS: Anxiety and message effectiveness for those individuals exposed only to the social loss-framed message, $r = .100$, $p = .628$.

Hypothesis 5: Self-report risk taking driving behaviour

H.5. It was anticipated that individuals who are more sensitive to rewards would report greater engagement in risky driving behaviour than those individuals who are less sensitive to rewards.

Higher scores on CW BAS: Drive was associated with greater risky driving behaviour at time 2. There were no other significant relationships between Carver and White's BIS/ BAS traits and risky driving behaviour (see Table D.4).

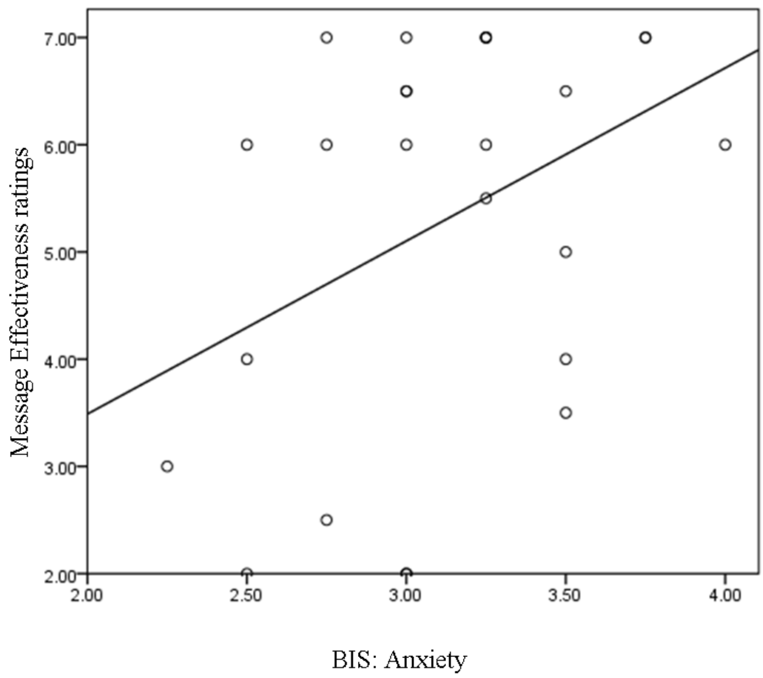


Figure D.2. Partial correlation of CW BIS: Anxiety and message effectiveness ratings of the social loss-framed message for individuals exposed to the mixed message condition.

Table D.4

Bivariate Correlations between CW BAS/ FFFS Traits and Self-reported Risky Driving Behaviour (measured 1 week later)

	Risky driving behaviour scores	
	Time 1	Time 2
BAS Subscales		
CW BAS: Reward Responsiveness	-.010	.064
CW BAS: Drive	.151	.250*
CW BAS: Fun Seeking	.156	.157
FFFS Subscales		
CW FFFS: Fear	-.129	-.181

Note. CW = Carver and White BIS/ BAS Scales
* *p* < .05

Hypothesis 6: Optimism bias

H.6. Individuals with stronger BAS traits would demonstrate greater driving-related optimism bias (i.e., perceive themselves to be more skilful, safer, more experienced, less risky, and less likely to be involved in a speed-related crash compared to same aged peers) than those with weaker BAS traits.

The results revealed that there were significant weak to moderate positive relationships between CW BAS: Fun Seeking and risky driving behaviour and between CW BAS: Fun Seeking and crash risk. These findings indicated that individuals high on CW BAS: Fun Seeking rated themselves as riskier than the average young driver and perceived themselves to have higher speed-related crash risk than a ‘typical young driver’. There were no other significant relationships between Carver and White’s BIS/ BAS Scales and optimism bias (see Table D.5).

Table D.5

Bivariate Correlations between CW BAS/ FFFS Traits and Optimism Bias Items

	Skilful	Safe	Experience	Risky	Crash
BAS Subscales					
CW BAS: Reward Responsiveness	.096	.061	.074	-.023	-.118
CW BAS: Drive	.135	.008	.130	.061	.056
CW BAS: Fun Seeking	.086	-.159	.002	.287*	.235*
FFFS Subscales					
CW FFFS: Fear	-.159	-.043	-.035	.021	-.032

Note. CW = Carver and White BIS/ BAS Scales
* $p < .001$

Appendix E

Mediation Analyses: BAS and Physical Gain-framed Message

Table E.1

Mediation Statistics: BAS and Physical Gain-framed Message on Message Effectiveness

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CW BAS: Reward Responsiveness				
BAS-RT-effectiveness				
a (BAS-RT)	-9.43	33.75	-78.95, 60.09	.782
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.691
ć (BAS-effectiveness)	-0.31	0.74	-1.85, 1.22	.676
ab	0.02	0.16	-0.16, 0.56	> .05
CW BAS: Drive				
BAS-RT-effectiveness				
a (BAS-RT)	-17.64	18.72	-56.19, 20.92	.355
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.511
ć (BAS-effectiveness)	-0.61	0.41	-1.46, 0.23	.146
ab	0.05	0.10	-0.0, 0.36	> .05
CW BAS: Fun Seeking				
BAS-RT-effectiveness				
a (BAS-RT)	24.62	19.20	-14.92, 64.16	.211
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.766
ć (BAS-effectiveness)	-0.12	0.45	-1.05, 0.81	.794
ab	-0.03	0.13	-0.37, 0.14	> .05
Jackson's BAS				
BAS-RT-effectiveness				
a (BAS-RT)	3.25	22.41	-42.91, 49.41	.886
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.716
ć (BAS-effectiveness)	-0.20	0.49	-1.21, 0.82	.693
ab	-0.01	0.20	-0.39, 0.31	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC BAS: Reward Interest				
BAS-RT-effectiveness				
a (BAS-RT)	-13.75	26.04	-67.39, 39.89	.602
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.622
ć (BAS-effectiveness)	-0.62	0.57	-1.79, 0.55	.287
ab	0.03	0.12	-0.10, 0.46	> .05
CC BAS: Goal-Drive Persistence				
BAS-RT-effectiveness				
a (BAS-RT)	-15.86	25.52	-68.42, 36.70	.540
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.677
ć (BAS-effectiveness)	-0.21	0.57	-1.38, 0.97	.719
ab	0.03	0.10	-0.08, 0.33	> .05
CC BAS: Reward Reactivity				
BAS-RT-effectiveness				
a (BAS-RT)	-21.27	25.33	-73.44, 30.91	.409
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.585
ć (BAS-effectiveness)	-0.58	0.56	-1.74, 0.58	.310
ab	0.05	0.14	-0.10, 0.54	> .05
CC BAS: Impulsivity				
BAS-RT-effectiveness				
a (BAS-RT)	2.94	29.06	-56.91, 62.79	.920
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.710
ć (BAS-effectiveness)	-0.09	0.64	-1.41, 1.23	.889
ab	< 0.01	0.12	-0.35, 0.13	> .05
CC BAS: Defensive Fight				
BAS-RT-effectiveness				
a (BAS-RT)	3.90	29.06	-56.91, 62.79	.887
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.728
ć (BAS-effectiveness)	-1.03	0.64	-2.20, 0.13	.078
ab	-0.01	0.12	-0.37, 0.16	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table E.2

Mediation Statistics: BAS and Physical Gain-framed Message on Attitudes

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CW BAS: Reward Responsiveness				
BAS-RT-attitudes				
a (BAS-RT)	9.43	33.75	-78.95, 60.09	.782
b (RT-attitudes)	< 0.01	< 0.01	-0.01, 0.00	.732
ć (BAS-attitudes)	0.35	0.36	-0.41, 1.10	.353
ab	0.01	0.08	-0.08, 0.27	> .05
CW BAS: Drive				
BAS-RT- attitudes				
a (BAS-RT)	17.64	18.72	-56.19, 20.92	.355
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.601
ć (BAS- attitudes)	-0.16	0.21	-0.59, 0.28	.458
ab	0.02	0.05	-0.04, 0.19	> .05
CW BAS: Fun Seeking				
BAS-RT- attitudes				
a (BAS-RT)	24.62	19.20	-14.92, 64.16	.211
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.797
ć (BAS- attitudes)	-0.11	0.22	-0.57, 0.35	.625
ab	-0.01	0.07	-0.25, 0.07	> .05
Jackson's BAS				
BAS-RT- attitudes				
a (BAS-RT)	3.25	22.41	-42.91, 49.41	.886
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.675
ć (BAS- attitudes)	0.21	0.24	-0.29, 0.71	.398
ab	< 0.01	0.08	-0.18, 0.17	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC BAS: Reward Interest				
BAS-RT- attitudes				
a (BAS-RT)	-13.75	26.04	-67.36, 39.38	.602
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.734
ć (BAS- attitudes)	0.13	0.29	-0.46, 0.73	.649
ab	0.01	0.07	-0.06, 0.24	> .05
CC BAS: Goal-Drive Persistence				
BAS-RT- attitudes				
a (BAS-RT)	-15.86	25.52	-68.42, 36.70	.540
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.717
ć (BAS- attitudes)	0.05	0.28	-0.54, 0.64	.852
ab	0.01	0.06	-0.05, 0.22	> .05
CC BAS: Reward Reactivity				
BAS-RT- attitudes				
a (BAS-RT)	-21.27	25.33	-73.44, 30.91	.409
b (RT- attitudes)	< 0.01	< 0.01	0.00, 0.00	.833
ć (BAS- attitudes)	0.31	0.28	-0.26, 0.89	.275
ab	0.01	0.07	-0.08, 0.22	> .05
CC BAS: Impulsivity				
BAS-RT-effectiveness				
a (BAS-RT)	2.94	29.06	-56.91, 62.79	.920
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.705
ć (BAS-effectiveness)	-0.22	0.32	-0.87, 0.43	.491
ab	< 0.01	0.05	-0.13, 0.07	> .05
CC BAS: Defensive Fight				
BAS-RT- attitudes				
a (BAS-RT)	3.90	27.22	-52.18, 59.97	.887
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.708
ć (BAS- attitudes)	-0.18	0.30	-0.79, 0.44	.556
ab	< 0.01	0.06	-0.16, 0.08	> .05

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table E.3

Mediation Statistics: BAS and Physical Gain-framed Message on Behavioural Intentions

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CW BAS: Reward Responsiveness				
BAS-RT-intentions				
a (BAS-RT)	-9.43	33.75	-78.79, 60.09	.782
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.745
ć (BAS- intentions)	0.578	0.47	-0.41, 1.56	.238
ab	0.01	0.10	-0.08, 0.29	> .05
CW BAS: Drive				
BAS-RT- intentions				
a (BAS-RT)	-17.64	18.72	-56.91, 20.92	.355
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.673
ć (BAS- intentions)	-0.07	0.28	-0.65, 0.51	.801
ab	0.02	0.06	-0.05, 0.19	> .05
CW BAS: Fun Seeking				
BAS-RT- intentions				
a (BAS-RT)	24.62	19.20	-14.92, 64.16	.211
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.991
ć (BAS- intentions)	-0.46	0.28	-1.03, 0.12	.116
ab	< 0.01	0.08	-0.11, 0.19	> .05
Jackson’s BAS				
BAS-RT- intentions				
a (BAS-RT)	3.25	22.41	-42.19, 49.41	.886
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.708
ć (BAS- intentions)	-0.08	0.32	-0.75, 0.59	.805
ab	< 0.01	0.11	-0.19, 0.27	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC BAS: Reward Interest				
BAS-RT- intentions				
a (BAS-RT)	-13.75	26.04	-67.39, 39.38	.602
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.684
ć (BAS- intentions)	-0.10	0.38	-0.88, 0.68	.795
ab	0.02	0.07	-0.06, 0.26	> .05
CC BAS: Goal-Drive Persistence				
BAS-RT- intentions				
a (BAS-RT)	-15.86	25.52	-68.42, 36.70	.540
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.667
ć (BAS- intentions)	-0.15	0.37	-0.92, 0.62	.683
ab	0.02	0.07	-0.04, 0.33	> .05
CC BAS: Reward Reactivity				
BAS-RT- intentions				
a (BAS-RT)	-21.27	25.33	-73.44, 30.91	.409
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.721
ć (BAS- intentions)	0.04	0.38	-0.73, 0.82	.907
ab	0.02	0.08	-0.07, 0.30	> .05
CC BAS: Impulsivity				
BAS-RT-effectiveness				
a (BAS-RT)	2.94	29.06	-56.91, 62.79	.920
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.712
ć (BAS-effectiveness)	-0.61	0.40	-1.44, 0.22	.141
ab	< 0.01	0.07	-0.18, 0.07	> .05
CC BAS: Defensive Fight				
BAS-RT- intentions				
a (BAS-RT)	3.90	27.22	-52.18, 59.97	.887
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.718
ć (BAS- intentions)	-0.98	0.34	-1.67, -0.28	.008
ab	< 0.01	0.07	-0.19, 0.08	> .05

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table E.4

Mediation Statistics: BAS and Physical Gain-framed Message on Message Compliance

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CW BAS: Reward Responsiveness				
BAS-RT-compliance				
a (BAS-RT)	-9.39	35.15	-82.11, 63.33	.792
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.698
ć (BAS- compliance)	0.08	0.54	-1.04, 1.20	.880
ab	0.01	0.11	-0.13, 0.34	> .05
CW BAS: Drive				
BAS-RT- compliance				
a (BAS-RT)	-28.21	21.75	-73.19, 16.78	.208
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.00	.570
ć (BAS- compliance)	-0.25	0.35	-0.98, 0.49	.489
ab	0.05	0.10	-0.09, 0.30	> .05
CW BAS: Fun Seeking				
BAS-RT- compliance				
a (BAS-RT)	23.96	20.81	-19.09, 67.01	.261
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.735
ć (BAS- compliance)	-0.07	0.34	-0.77, 0.63	.835
ab	-0.03	0.11	-0.29, 0.10	> .05
Jackson's BAS				
BAS-RT- compliance				
a (BAS-RT)	4.76	24.00	-44.90, 54.41	.845
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.658
ć (BAS- compliance)	0.34	0.36	-0.41, 1.09	.363
ab	-0.01	0.12	-0.26, 0.29	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC BAS: Reward Interest				
BAS-RT- compliance				
a (BAS-RT)	-16.22	28.09	-74.34, 41.89	.569
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.666
ć (BAS- compliance)	-0.14	0.44	-1.04, 0.77	.759
ab	0.03	0.11	-0.08, 0.33	> .05
CC BAS: Goal-Drive Persistence				
BAS-RT- compliance				
a (BAS-RT)	-13.74	27.41	-70.45, 42.97	.621
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.681
ć (BAS- compliance)	-0.07	0.42	-0.95, 0.82	.880
ab	0.02	0.09	-0.10, 0.32	> .05
CC BAS: Reward Reactivity				
BAS-RT- compliance				
a (BAS-RT)	-26.10	27.97	-83.96, 31.75	.360
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.814
ć (BAS- compliance)	0.37	0.43	-0.53, 1.28	.402
ab	0.02	0.11	-0.14, 0.34	> .05
CC BAS: Impulsivity				
BAS-RT-effectiveness				
a (BAS-RT)	-1.64	33.89	-71.74, 68.46	.962
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.683
ć (BAS-effectiveness)	-0.35	0.51	-1.42, 0.71	.500
ab	< 0.01	0.12	-0.19, 0.21	> .05
CC BAS: Defensive Fight				
BAS-RT- compliance				
a (BAS-RT)	6.43	30.37	-56.41, 69.26	.834
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.728
ć (BAS- compliance)	-0.76	0.44	-1.67, 0.15	.096
ab	< 0.01	0.10	-0.27, 0.14	> .05

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Appendix F

Mediation Analyses: BAS and Social Gain-framed Message

Table F.1

Mediation Statistics: BAS and Social Gain-framed Message on Message Effectiveness

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CW BAS: Reward Responsiveness				
BAS-RT-effectiveness				
a (BAS-RT)	-35.72	31.39	-100.50, 29.06	.266
b (RT-effectiveness)	< 0.01	0.01	-0.01, 0.01	.855
ć (BAS-effectiveness)	0.44	0.81	-1.23, 2.11	.593
ab	0.03	0.25	-0.28, 0.88	> .05
CW BAS: Drive				
BAS-RT-effectiveness				
a (BAS-RT)	-13.96	23.39	-62.24, 34.32	.556
b (RT-effectiveness)	< 0.01	0.01	-0.01, 0.01	.811
ć (BAS-effectiveness)	0.34	0.58	-0.85, 1.54	.559
ab	0.02	0.10	-0.10, 0.41	> .05
CW BAS: Fun Seeking				
BAS-RT-effectiveness				
a (BAS-RT)	-25.51	20.80	-68.44, 17.42	.232
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.424
ć (BAS-effectiveness)	-1.00	0.50	-2.03, 0.04	.058
ab	0.10	0.19	-0.05, 0.77	> .05
Jackson's BAS				
BAS-RT-effectiveness				
a (BAS-RT)	-33.37	33.10	-101.55, 34.80	.323
b (RT-effectiveness)	< 0.01	0.01	-0.01, 0.01	.535
ć (BAS-effectiveness)	-0.56	0.84	-2.29, 1.18	.513
ab	0.10	0.23	-0.12, 0.94	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC BAS: Reward Interest				
BAS-RT-effectiveness				
a (BAS-RT)	-12.96	29.23	-73.16, 47.24	.661
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.577
ć (BAS-effectiveness)	-0.48	0.72	-1.96, 1.01	.514
ab	0.04	0.14	-0.11, 0.55	> .05
CC BAS: Goal-Drive Persistence				
BAS-RT-effectiveness				
a (BAS-RT)	-6.82	28.67	-65.88, 52.23	.814
b (RT-effectiveness)	< 0.01	0.01	-0.01, 0.01	.634
ć (BAS-effectiveness)	0.36	0.70	-1.10, 1.81	.617
ab	0.02	0.13	-0.11, 0.48	> .05
CC BAS: Reward Reactivity				
BAS-RT-effectiveness				
a (BAS-RT)	-28.44	28.25	-86.62, 29.74	.324
b (RT-effectiveness)	< 0.01	0.01	-0.01, 0.01	.643
ć (BAS-effectiveness)	0.09	0.73	-1.40, 1.58	.901
ab	0.07	0.18	-0.12, 0.73	> .05
CC BAS: Impulsivity				
BAS-RT-effectiveness	-8.31	26.64	-63.18, 46.57	.758
a (BAS-RT)	< 0.01	< 0.01	-0.01, 0.01	.588
b (RT-effectiveness)	-0.43	0.65	-1.78, 0.92	.519
ć (BAS-effectiveness)	0.02	0.09	-0.07, 0.38	> .05
ab				
CC BAS: Defensive Fight				
BAS-RT-effectiveness				
a (BAS-RT)	-2.87	25.83	-56.07, 50.33	.912
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.534
ć (BAS-effectiveness)	-1.48	0.56	-2.64, -0.33	.014
ab	0.01	0.12	-0.16, 0.39	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table F.2

Mediation Statistics: BAS and Social Gain-framed Message on Attitudes

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CW BAS: Reward Responsiveness				
BAS-RT-attitudes				
a (BAS-RT)	-35.72	31.39	-100.50, 29.06	.266
b (RT-attitudes)	< 0.01	< 0.01	-0.01, 0.00	.867
ć (BAS-attitudes)	-0.10	0.57	-1.29, 1.09	.863
ab	-0.02	0.14	-0.46, 0.13	> .05
CW BAS: Drive				
BAS-RT- attitudes				
a (BAS-RT)	-13.96	23.39	-62.24, 34.32	.556
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.743
ć (BAS- attitudes)	0.38	0.40	-0.45, 1.22	.312
ab	-0.02	0.06	-0.20, 0.04	> .05
CW BAS: Fun Seeking				
BAS-RT- attitudes				
a (BAS-RT)	-25.51	20.80	-68.44, 17.42	.232
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.763
ć (BAS- attitudes)	0.77	0.35	-1.49, -0.05	.038
ab	0.03	0.10	-0.05, 0.38	> .05
Jackson's BAS				
BAS-RT- attitudes				
a (BAS-RT)	-33.37	33.10	-101.55, 34.80	.323
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.945
ć (BAS- attitudes)	-0.29	0.59	-1.50, 0.92	.621
ab	-0.01	0.09	-0.26, 0.12	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC BAS: Reward Interest				
BAS-RT- attitudes				
a (BAS-RT)	-12.96	29.23	-73.16, 47.24	.661
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.930
ć (BAS- attitudes)	-0.48	0.49	-1.50, 0.54	.344
ab	< 0.01	0.06	-0.17, 0.07	> .05
CC BAS: Goal-Drive Persistence				
BAS-RT- attitudes				
a (BAS-RT)	-6.82	28.67	-65.88, 52.23	.814
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.840
ć (BAS- attitudes)	0.32	0.49	-0.69, 1.32	.520
ab	< 0.01	0.09	-0.24, 0.07	> .05
CC BAS: Reward Reactivity				
BAS-RT- attitudes				
a (BAS-RT)	-28.44	28.25	-86.62, 29.74	.324
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.861
ć (BAS- attitudes)	0.02	0.50	-1.01, 1.06	.965
ab	-0.02	0.12	-0.49, 0.10	> .05
CC BAS: Impulsivity				
BAS-RT-effectiveness				
a (BAS-RT)	-8.31	26.64	-63.18, 46.57	.758
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.899
ć (BAS-effectiveness)	-0.32	0.45	-1.26, 0.61	.479
ab	< 0.01	0.04	-0.13, 0.04	> .05
CC BAS: Defensive Fight				
BAS-RT- attitudes				
a (BAS-RT)	-2.87	25.83	-56.07, 50.33	.912
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.893
ć (BAS- attitudes)	-1.03	0.39	-0.1.83, -0.23	.014
ab	< 0.01	0.06	-0.18, 0.05	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table F.3

Mediation Statistics: BAS and Social Gain-framed Message on Behavioural Intentions

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CW BAS: Reward Responsiveness				
BAS-RT-intentions				
a (BAS-RT)	-35.72	31.39	-100.50, 29.06	.266
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.847
ć (BAS- intentions)	0.06	0.50	-0.98, 1.09	.910
ab	0.02	0.16	-0.16, 0.62	> .05
CW BAS: Drive				
BAS-RT- intentions				
a (BAS-RT)	-13.96	23.39	-62.24, 34.32	.556
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.949
ć (BAS- intentions)	0.48	0.35	-0.23, 1.20	.174
ab	< 0.01	0.06	-0.12, 0.15	> .05
CW BAS: Fun Seeking				
BAS-RT- intentions				
a (BAS-RT)	-25.51	20.80	-68.44, 17.42	.232
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.395
ć (BAS- intentions)	-0.75	0.30	-1.37, -0.14	.018
ab	0.06	0.12	-0.04, 0.49	> .05
Jackson's BAS				
BAS-RT- intentions				
a (BAS-RT)	-33.37	33.10	-101.55, 34.30	.323
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.653
ć (BAS- intentions)	-0.35	0.51	-1.41, 0.70	.497
ab	0.05	0.14	-0.10, 0.57	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC BAS: Reward Interest				
BAS-RT- intentions				
a (BAS-RT)	-12.96	29.23	-73.16, 47.24	.661
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.659
ć (BAS- intentions)	-0.55	0.43	-1.43, 0.33	.208
ab	0.17	0.10	-0.08, 0.34	> .05
CC BAS: Goal-Drive Persistence				
BAS-RT- intentions				
a (BAS-RT)	-6.82	28.67	-65.88, 52.23	.814
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.764
ć (BAS- intentions)	0.18	0.43	-0.71, 1.06	.680
ab	0.01	0.08	-0.09, 0.25	> .05
CC BAS: Reward Reactivity				
BAS-RT- intentions				
a (BAS-RT)	-28.44	28.25	-86.62, 29.74	.324
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.746
ć (BAS- intentions)	-0.03	0.44	-0.93, 0.88	.952
ab	0.03	0.12	-0.12, 0.43	> .05
CC BAS: Impulsivity				
BAS-RT-effectiveness				
a (BAS-RT)	-8.31	26.64	-63.18, 46.57	.758
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.711
ć (BAS-effectiveness)	-0.31	0.40	-1.13, 0.51	.439
ab	0.01	0.05	-0.05, 0.19	> .05
CC BAS: Defensive Fight				
BAS-RT- intentions				
a (BAS-RT)	-2.87	25.83	-56.07, 50.33	.912
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.689
ć (BAS- intentions)	-0.79	0.35	-1.51, -0.06	.034
ab	< 0.01	0.07	-0.11, 0.17	> .05

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table F.4

Mediation Statistics: BAS and Social Gain-framed Message on Message Compliance

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CW BAS: Reward Responsiveness				
BAS-RT-compliance				
a (BAS-RT)	-36.54	47.70	-139.60, 66.53	.457
b (RT- compliance)	-0.01	< 0.01	-0.01, 0.00	.061
ć (BAS- compliance)	-0.29	0.49	-1.37, 0.78	.563
ab	0.22	0.34	-0.24, 1.19	> .05
CW BAS: Drive				
BAS-RT- compliance				
a (BAS-RT)	-0.65	36.11	-78.67, 77.36	.986
b (RT- compliance)	-0.01	< 0.01	-0.01, 0.00	.047
ć (BAS- compliance)	0.59	0.32	-0.12, 1.29	.089
ab	< 0.01	0.29	-0.54, 0.63	> .05
CW BAS: Fun Seeking				
BAS-RT- compliance				
a (BAS-RT)	-37.29	31.45	105.24, 30.67	.257
b (RT- compliance)	-0.01	< 0.01	-0.01, 0.00	.076
ć (BAS- compliance)	-0.08	0.35	-0.84, 0.68	.824
ab	0.21	0.33	-0.10, 1.30	> .05
Jackson's BAS				
BAS-RT- compliance				
a (BAS-RT)	-11.21	45.34	-108.46, 86.04	.808
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.00	.961
ć (BAS- compliance)	0.08	0.44	-0.88, 1.03	.369
ab	0.06	0.27	-0.33, 0.81	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC BAS: Reward Interest				
BAS-RT- compliance				
a (BAS-RT)	34.63	43.04	-57.70, 126.96	.435
b (RT- compliance)	-0.01	< 0.01	-0.01, 0.00	.055
ć (BAS- compliance)	0.16	0.44	-0.79, 1.11	.721
ab	-0.20	0.30	-1.06, 0.21	> .05
CC BAS: Goal-Drive Persistence				
BAS-RT- compliance				
a (BAS-RT)	21.08	42.44	-69.96, 112.13	.627
b (RT- compliance)	-0.01	< 0.01	-0.01, 0.00	.047
ć (BAS- compliance)	0.32	0.41	-0.58, 1.21	.458
ab	-0.12	0.52	-2.49, 0.52	> .05
CC BAS: Reward Reactivity				
BAS-RT- compliance				
a (BAS-RT)	-29.78	40.39	-116.43, 56.86	.473
b (RT- compliance)	0.01	< 0.01	-0.01, 0.00	.067
ć (BAS- compliance)	< 0.01	0.36	-0.88, 0.89	.996
ab	0.16	0.27	-0.20, 0.99	> .05
CC BAS: Impulsivity				
BAS-RT-effectiveness				
a (BAS-RT)	14.05	40.40	-72.61, 100.71	.733
b (RT-effectiveness)	-0.01	< 0.01	-0.01, 0.00	.061
ć (BAS-effectiveness)	-0.03	0.40	-0.89, 0.83	.950
ab	-0.08	0.22	-0.72, 0.23	> .05
CC BAS: Defensive Fight				
BAS-RT- compliance				
a (BAS-RT)	28.46	36.03	-48.82, 105.74	.443
b (RT- compliance)	< 0.01	< 0.01	-0.02, 0.00	.081
ć (BAS- compliance)	-0.34	0.36	-1.10, 0.43	.361
ab	-0.14	0.27	-1.10, 0.12	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Appendix G

Mediation Analyses: FFFS and Physical Loss-framed Message

Table G.1

Mediation Statistics: FFFS and Physical Loss-framed Message on Message Effectiveness

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC FFFS				
FFFS-RT-effectiveness				
a (FFFS-RT)	-42.17	23.68	-90.94, 6.59	.087
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.881
ć (FFFS-effectiveness)	0.33	0.60	-0.90, 1.57	.583
ab	-0.03	0.31	-0.77, 0.48	> .05
CC Panic				
Panic-RT-effectiveness				
a (Panic-RT)	9.94	20.17	-31.60, 51.49	.626
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.896
ć (Panic-effectiveness)	0.43	0.45	-0.50, 1.36	.346
ab	-0.01	0.17	-0.40, 0.26	> .05
CW FFFS: Fear				
FFFS-RT-effectiveness				
a (FFFS-RT)	-6.95	24.51	-57.43, 43.53	.779
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.996
ć (FFFS-effectiveness)	0.31	0.55	-0.83, 1.45	.579
ab	< 0.01	0.15	-0.44, 0.23	> .05
Jackson's FFFS				
FFFS-RT-effectiveness				
a (FFFS-RT)	-57.00	37.30	-77.39, 76.25	.988
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.973
ć (FFFS-effectiveness)	0.77	0.82	-0.93, 2.47	.363
ab	< 0.01	0.22	-0.49, 0.36	> .05
Jackson's Fight				
Fight-RT-effectiveness				
a (Fight-RT)	34.65	18.70	-3.86, 73.16	.079
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.982
ć (Fight-effectiveness)	-0.08	0.48	-1.07, 0.91	.870
ab	< 0.01	0.22	-0.39, 0.54	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Jackson's Flight				
Flight-RT-effectiveness				
a (Flight-RT)	-28.98	38.70	-108.70, 50.74	.461
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.893
ć (Flight-effectiveness)	1.02	0.87	-0.77, 2.81	.252
ab	-0.02	0.32	-1.09, 0.41	> .05
Jackson's Freezing				
Freezing-RT-effectiveness				
a (Freezing-RT)	-17.49	21.79	-62.37, 27.38	.430
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.01	.873
ć (Freezing-effectiveness)	0.61	0.49	-0.39, 1.62	.221
ab	-0.01	0.17	-0.57, 0.21	> .05

CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table G.2

Mediation Statistics: FFFS and Physical Loss-framed Message on Attitudes

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC FFFS				
FFFS-RT-attitudes				
a (FFFS-RT)	-42.17	23.68	-90.94, 6.59	.087
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.01	.891
ć (FFFS- attitudes)	0.67	0.37	-0.12, 1.44	.086
ab	0.02	0.18	-0.26, 0.51	> .05
CC Panic				
Panic-RT- attitudes				
a (Panic-RT)	9.94	20.17	-31.60, 51.49	.626
b (RT-e attitudes)	< 0.01	< 0.01	-0.01, 0.00	.386
ć (Panic- attitudes)	0.37	0.29	-0.23, 0.98	.216
ab	-0.03	0.12	-0.42, 0.11	> .05
CW FFFS: Fear				
FFFS-RT- attitudes				
a (FFFS-RT)	-6.95	24.51	-57.43, 43.53	.779
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.498
ć (FFFS- attitudes)	0.48	0.35	-0.25, 1.21	.185
ab	0.01	0.10	-0.07, 0.34	> .05
Jackson's FFFS				
FFFS-RT- attitudes				
a (FFFS-RT)	-57.00	37.30	-77.39, 76.25	.988
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.424
ć (FFFS- attitudes)	1.19	0.50	0.17, 2.23	.025
ab	< 0.01	0.15	-0.29, 0.36	> .05
Jackson's Fight				
Fight-RT- attitudes				
a (Fight-RT)	34.64	18.70	-3.86, 73.16	.076
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.598
ć (Fight- attitudes)	-0.15	0.32	-0.80, 0.51	.649
ab	-0.06	0.16	-0.59, 0.11	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Jackson's Flight				
Flight-RT- attitudes				
a (Flight-RT)	-28.98	38.70	-108.70, 50.74	.461
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.656
ć (Flight- attitudes)	1.30	0.53	0.21, 2.39	.021
ab	0.04	0.15	-0.11, 0.59	> .05
Jackson's Freezing				
Freezing-RT- attitudes				
a (Freezing-RT)	-17.49	21.79	-62.37, 27.33	.430
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.683
ć (Freezing- attitudes)	0.76	0.29	0.16, 1.37	.016
ab	0.02	0.11	-0.07, 0.47	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table G.3

Mediation Statistics: FFFS and Physical Loss-framed Message on Behavioural Intentions

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC FFFS				
FFFS-RT-intentions				
a (FFFS-RT)	-42.17	23.68	-90.94, 6.59	.087
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.777
ć (FFFS- intentions)	0.45	0.37	-0.31, 1.21	.230
ab	-0.04	0.17	-0.51, 0.23	> .05
CC Panic				
Panic-RT- intentions				
a (Panic-RT)	9.94	20.17	-31.60, 51.49	.626
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.796
ć (Panic- intentions)	0.36	0.28	-0.22, 0.94	.210
ab	-0.01	0.10	-0.36, 0.16	> .05
CW FFFS: Fear				
FFFS-RT- intentions				
a (FFFS-RT)	-6.95	24.51	-57.43, 43.53	.779
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.962
ć (FFFS- intentions)	0.52	0.33	-0.17, 1.21	.131
ab	< 0.01	0.08	-0.16, 0.15	> .05
Jackson’s FFFS				
FFFS-RT- intentions				
a (FFFS-RT)	-57.00	37.30	-77.39, 76.25	.988
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.898
ć (FFFS- intentions)	0.50	0.52	-0.58, 1.57	.348
ab	< 0.01	0.12	-0.28, 0.23	> .05
Jackson’s Fight				
Fight-RT- intentions				
a (Fight-RT)	34.65	18.70	-3.86, 73.16	.076
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.866
ć (Fight- intentions)	-0.25	0.30	-0.87, 0.36	.405
ab	0.02	0.12	-0.18, 0.31	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Jackson's Flight				
Flight-RT- intentions				
a (Flight-RT)	-28.98	38.70	-108.70, 50.74	.461
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.01	.950
ć (Flight- intentions)	0.72	0.54	-0.40, 1.84	.196
ab	-0.01	0.17	-0.40, 0.30	> .05
Jackson's Freezing				
Freezing-RT- intentions				
a (Freezing-RT)	-17.49	21.79	-62.37, 27.33	.430
b (RT- intentions)	< 0.01	< 0.01	0.00, 0.01	.848
ć (Freezing- intentions)	0.61	0.29	0.01, 1.22	.046
ab	-0.01	0.09	-0.30, 0.11	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table G.4

Mediation Statistics: FFFS and Physical Loss-framed Message on Message Compliance

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC FFFS				
FFFS-RT-compliance				
a (FFFS-RT)	-37.40	29.70	-99.57, 24.78	.223
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.844
ć (FFFS- compliance)	0.56	0.40	-0.28, 1.40	.177
ab	-0.02	0.20	-0.59, 0.29	> .05
CC Panic				
Panic-RT- compliance				
a (Panic-RT)	8.76	23.46	-40.35, 57.86	.713
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.787
ć (Panic- compliance)	0.29	0.30	-0.34, 0.92	.348
ab	-0.01	0.13	-0.41, 0.13	> .05
CW FFFS: Fear				
FFFS-RT- compliance				
a (FFFS-RT)	-8.50	32.14	-75.77, 58.76	.794
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.934
ć (FFFS- compliance)	0.78	0.38	-0.01, 1.58	.054
ab	< 0.01	0.11	-0.34, 0.20	> .05
Jackson’s FFFS				
FFFS-RT-compliance				
a (FFFS-RT)	-18.01	44.95	-112.10, 76.08	.693
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.962
ć (FFFS- compliance)	0.92	0.55	-0.24, 2.08	.112
ab	< 0.01	0.23	-0.26, 0.52	> .05
Jackson’s Fight				
Fight-RT-compliance				
a (Fight-RT)	30.27	23.71	-19.36, 79.90	.217
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.938
ć (Fight- compliance)	-0.31	0.33	-1.00, 0.38	.360
ab	0.01	0.14	-0.25, 0.29	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Jackson’s Flight				
Flight-RT-compliance				
a (Flight-RT)	-44.85	46.74	-142.69, 52.99	.349
b (RT-compliance)	< 0.01	< 0.01	-0.01, 0.01	.942
ć (Flight-compliance)	0.33	0.64	-1.01, 1.67	.610
ab	0.01	0.32	-0.36, 0.80	> .05
Jackson’s Freezing				
Freezing-RT-compliance				
a (Freezing-RT)	-24.09	24.65	-75.68, 27.49	.341
b (RT-compliance)	< 0.01	< 0.01	-0.01, 0.01	.815
ć (Freezing-compliance)	0.62	0.31	-0.03, 1.26	.059
ab	-0.02	0.12	-0.41, 0.15	> .05

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Appendix H

Mediation Analyses: FFFS and Social Loss-framed Message

Table H.1

Mediation Statistics: FFFS and Social Loss-framed Message on Message Effectiveness

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC FFFS				
FFFS-RT-effectiveness				
a (FFFS-RT)	-17.03	26.79	-72.12, 38.15	.531
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.354
ć (FFFS-effectiveness)	0.02	0.47	-0.95, 0.99	.963
ab	0.06	0.14	-0.07, 0.63	> .05
CC Panic				
Panic-RT-effectiveness				
a (Panic-RT)	10.38	19.58	-29.95, 50.71	.601
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.361
ć (Panic-effectiveness)	0.07	0.34	-0.77, 0.63	.841
ab	-0.03	0.13	-0.56, 0.08	> .05
CW FFFS: Fear				
FFFS-RT-effectiveness				
a (FFFS-RT)	-0.81	23.19	-48.56, 46.95	.972
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.341
ć (FFFS-effectiveness)	-0.27	0.40	-1.09, 0.55	.499
ab	< 0.01	0.11	-0.19, 0.30	> .05
Jackson's FFFS				
FFFS-RT-effectiveness				
a (FFFS-RT)	-52.79	37.92	-130.88, 25.30	.176
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.323
ć (FFFS-effectiveness)	-0.22	0.70	-1.67, 1.23	.755
ab	0.19	0.30	-0.11, 1.29	> .05
Jackson's Fight				
Fight-RT-effectiveness				
a (Fight-RT)	-6.95	19.01	-46.10, 32.19	.718
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.270
ć (Fight-effectiveness)	-0.51	0.31	-1.16, 0.13	.113
ab	0.03	0.09	-0.07, 0.36	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Jackson's Flight				
Flight-RT-effectiveness				
a (Flight-RT)	-19.77	27.31	-76.01, 36.47	.476
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.370
ć (Flight-effectiveness)	0.12	0.48	-0.87, 1.11	.810
ab	0.06	0.16	-0.07, 0.81	> .05
Jackson's Freezing				
Freezing-RT-effectiveness				
a (Freezing-RT)	-19.73	19.73	-60.36, 20.90	.327
b (RT-effectiveness)	< 0.01	< 0.01	-0.01, 0.00	.354
ć (Freezing-effectiveness)	-0.01	0.35	-0.74, 0.72	.976
ab	0.07	0.14	-0.07, 0.62	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table H.2

Mediation Statistics: FFFS and Social Loss-framed Message on Attitudes

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC FFFS				
FFFS-RT-attitudes				
a (FFFS-RT)	-17.03	26.79	-72.21, 38.15	.531
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.641
ć (FFFS- attitudes)	0.36	0.38	-0.43, 1.15	.357
ab	0.02	0.10	-0.10, 0.39	> .05
CC Panic				
Panic-RT- attitudes				
a (Panic-RT)	10.38	19.58	-29.95, 50.71	.601
b (RT-e attitudes)	< 0.01	< 0.01	-0.01, 0.00	.563
ć (Panic- attitudes)	0.02	0.28	-0.57, 0.61	.951
ab	-0.02	0.10	-0.43, 0.07	> .05
CW FFFS: Fear				
FFFS-RT- attitudes				
a (FFFS-RT)	-0.81	23.19	-48.56, 46.45	.972
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.565
ć (FFFS- attitudes)	0.12	0.33	-0.56, 0.81	.715
ab	< 0.01	0.08	-0.11, 0.23	> .05
Jackson's FFFS				
FFFS-RT- attitudes				
a (FFFS-RT)	-52.79	37.92	-130.88, 25.30	.176
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.690
ć (FFFS- attitudes)	0.35	0.58	-0.85, 1.56	.550
ab	0.06	0.21	-0.24, 0.68	> .05
Jackson's Fight				
Fight-RT- attitudes				
a (Fight-RT)	-6.95	19.01	-46.10, 32.19	.718
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.491
ć (Fight- attitudes)	-0.35	0.27	-0.90, 0.20	.198
ab	0.01	0.06	-0.05, 0.24	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Jackson's Flight				
Flight-RT- attitudes				
a (Flight-RT)	-19.77	27.31	-76.01, 36.47	.476
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.571
ć (Flight- attitudes)	0.01	0.40	-0.81, 0.84	.975
ab	0.03	0.12	-0.07, 0.51	> .05
Jackson's Freezing				
Freezing-RT- attitudes				
a (Freezing-RT)	-19.73	19.73	-60.36, 20.90	.327
b (RT- attitudes)	< 0.01	< 0.01	-0.01, 0.00	.682
ć (Freezing- attitudes)	0.25	0.29	-0.35, 0.84	.404
ab	0.02	0.11	-0.10, 0.43	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table H.3

Mediation Statistics: FFFS and Social Loss-framed Message on Behavioural Intentions

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC FFFS				
FFFS-RT-intentions				
a (FFFS-RT)	-17.03	26.76	-72.21, 38.15	.531
b (RT- intentions)	< 0.01	< 0.01	0.00, 0.00	.968
ć (FFFS- intentions)	0.39	0.31	-0.25, 1.03	.221
ab	< 0.01	0.08	-0.16, 0.18	> .05
CC Panic				
Panic-RT- intentions				
a (Panic-RT)	10.38	19.58	-29.95, 50.71	.601
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.848
ć (Panic- intentions)	< 0.01	0.23	-0.48, 0.48	.995
ab	< 0.01	0.07	-0.17, 0.11	> .05
CW FFFS: Fear				
FFFS-RT- intentions				
a (FFFS-RT)	-0.81	23.19	-48.56, 46.95	.972
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.848
ć (FFFS- intentions)	0.06	0.27	-0.50, 0.62	.815
ab	< 0.01	0.06	-0.08, 0.13	> .05
Jackson's FFFS				
FFFS-RT- intentions				
a (FFFS-RT)	-52.79	37.92	-130.88, 25.30	.176
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.690
ć (FFFS- intentions)	0.35	0.58	-0.85, 1.56	.550
ab	0.06	0.21	-0.24, 0.68	> .05
Jackson's Fight				
Fight-RT- intentions				
a (Fight-RT)	-6.95	19.01	-46.10, 32.19	.718
b (RT- intentions)	< 0.01	< 0.01	-0.25, 0.81	.807
ć (Fight- intentions)	-0.15	0.22	-0.69, 0.50	.497
ab	< 0.01	0.04	-0.06, 0.11	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Jackson's Flight				
Flight-RT- intentions				
a (Flight-RT)	-19.77	27.31	-76.01, 36.47	.476
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.870
ć (Flight- intentions)	0.06	0.33	-0.61, 0.74	.847
ab	0.01	0.09	-0.13, 0.25	> .05
Jackson's Freezing				
Freezing-RT- intentions				
a (Freezing-RT)	-19.73	19.73	-60.36, 20.90	.327
b (RT- intentions)	< 0.01	< 0.01	-0.01, 0.00	.875
ć (Freezing- intentions)	0.04	0.24	-0.46, 0.53	.873
ab	0.01	0.07	-0.09, 0.20	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table H.4

Mediation Statistics: FFFS and Social Loss-framed Message on Message Compliance

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
CC FFFS				
FFFS-RT-compliance				
a (FFFS-RT)	-21.82	25.80	-75.63, 31.99	.408
b (RT- compliance)	0.01	< 0.01	0.00, 0.01	.246
ć (FFFS- compliance)	0.87	0.49	-0.16, 1.90	.094
ab	-0.11	0.21	-0.87, 0.08	> .05
CC Panic				
Panic-RT- compliance				
a (Panic-RT)	3.06	3.90	-4.98, 11.10	.440
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.00	.518
ć (Panic- compliance)	0.03	0.06	-0.09, 0.15	.628
ab	-0.01	0.02	-0.09, 0.01	> .05
CW FFFS: Fear				
FFFS-RT- compliance				
a (FFFS-RT)	-4.51	21.69	-49.76, 40.75	.838
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.386
ć (FFFS- compliance)	0.42	0.42	-0.46, 1.30	.328
ab	-0.02	0.12	-0.43, 0.12	> .05
Jackson's FFFS				
FFFS-RT-compliance				
a (FFFS-RT)	-70.58	36.19	-146.08, 4.91	.065
b (RT- compliance)	0.01	< 0.01	0.00, 0.02	.267
ć (FFFS- compliance)	0.79	0.84	-0.96, 2.53	.359
ab	-0.38	0.37	-1.27, 0.21	> .05
Jackson's Fight				
Fight-RT-compliance				
a (Fight-RT)	-15.82	17.56	-52.45, 20.82	.379
b (RT- compliance)	< 0.01	< 0.01	-0.01, 0.01	.523
ć (Fight- compliance)	-0.31	0.36	-1.05, 0.44	.407
ab	-0.05	0.10	-0.33, 0.07	> .05

Path/ effect	Bootstrapping			
	B	*SE*	BC 95% CI	*p*
Jackson's Flight				
Flight-RT-compliance				
a (Flight-RT)	-50.32	25.48	-103.47, 2.82	.062
b (RT-compliance)	< 0.01	< 0.01	-0.01, 0.01	.566
ć (Flight-compliance)	-0.25	0.60	-1.51, 1.01	.680
ab	-0.14	0.27	-0.54, 0.38	> .05
Jackson's Freezing				
Freezing-RT-compliance				
a (Freezing-RT)	-3.11	21.70	-48.38, 42.16	.887
b (RT-compliance)	< 0.01	< 0.01	-0.01, 0.01	.399
ć (Freezing-compliance)	0.37	0.42	-0.52, 1.25	.394
ab	-0.01	0.12	-0.38, 0.13	> .05

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Appendix I

ANOVA Effects: Physical Condition

Table I.1

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Message Processing (RT) for the Physical Message Conditions (n = 54)

Effect	F	p	η_p^2
CW BAS: Reward Responsiveness and framing on processing			
Reward Responsiveness	1.20	.279	.023
framing	0.39	.536	.008
Reward Responsiveness x framing	0.47	.498	.009
CW BAS: Drive and framing on processing			
Drive	1.23	.273	.024
framing	0.07	.796	.001
Drive x framing	0.02	.885	< .001
CC BAS: Reward Interest and framing on processing			
Reward Interest	< 0.01	.984	< .001
framing	0.89	.351	.017
Reward Interest x framing	0.75	.392	.015
CC BAS: Goal-Drive Persistence and framing on processing			
Goal-Drive Persistence	< 0.01	.971	< .001
framing	0.71	.404	.014
Goal-Drive Persistence x framing	0.62	.437	.012
CC BAS: Reward Reactivity and framing on processing			
Reward Reactivity	1.11	.297	.022
framing	0.02	.885	< .001
Reward Reactivity x framing	0.01	.939	< .001
CC BAS: Impulsivity and framing on processing			
Impulsivity	0.03	.856	.001
framing	0.07	.789	.001
Impulsivity x framing	0.11	.737	.002
CC BAS: Defensive Fight and framing on processing			
Defensive Fight	0.59	.444	.012
framing	0.42	.522	.008
Defensive Fight x framing	0.34	.562	.007
Jackson’s BAS and framing on processing			
BAS	0.02	.895	< .001
framing	< 0.01	.990	< .001
BAS x framing	< 0.01	.956	< .001

Table I.2

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Message Effectiveness for the Physical Message Conditions (n = 54)

Effect	F	p	η_p^2
CW BAS: Reward Responsiveness and framing on message effectiveness			
Reward Responsiveness	0.38	.540	.008
framing	1.12	.295	.022
Reward Responsiveness x framing	1.00	.323	.020
CW BAS: Drive and framing on message effectiveness			
Drive	1.00	.324	.019
framing	0.01	.919	< .001
Drive x framing	0.05	.822	.001
CC BAS: Reward Interest and framing on message effectiveness			
Reward Interest	0.01	.910	< .001
framing	< 0.01	.950	< .001
Reward Interest x framing	< 0.01	.958	< .001
CC BAS: Goal-Drive Persistence and framing on message effectiveness			
Goal-Drive Persistence	1.65	.206	.032
framing	0.56	.459	.011
Goal-Drive Persistence x framing	0.76	.401	.014
CC BAS: Reward Reactivity and framing on message effectiveness			
Reward Reactivity	0.88	.352	.017
framing	0.26	.613	.005
Reward Reactivity x framing	0.18	.674	.004
CC Defensive Fight and framing on message effectiveness			
Defensive Fight	0.03	.866	.001
framing	0.33	.567	.007
Defensive Fight x framing	0.24	.629	.005
Jackson's BAS and framing on message effectiveness			
BAS	0.35	.558	.007
framing	1.57	.216	.030
BAS x framing	1.37	.248	.027

Table I.3

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Attitudes for the Physical Message Conditions (n = 54)

Effect	*F*	*p*	η_p^2
CW BAS: Reward Responsiveness and framing on attitudes			
Reward Responsiveness	1.84	.181	.036
framing	0.03	.857	.001
Reward Responsiveness x framing	0.04	.845	.001
CW BAS: Drive and framing on attitudes			
Drive	0.74	.393	.015
framing	0.24	.625	.005
Drive x framing	0.20	.654	.004
CW BAS: Fun Seeking and framing on attitudes			
Fun Seeking	1.73	.195	.033
framing	0.51	.479	.010
Fun Seeking x framing	0.76	.388	.015
CC BAS: Reward Reactivity and framing on attitudes			
Reward Reactivity	0.01	.919	< .001
framing	0.78	.380	.015
Reward Reactivity x framing	0.86	.359	.017
CC Defensive Fight and framing on attitudes			
Defensive Fight	0.21	.648	.004
framing	1.88	.176	.036
Defensive Fight x framing	2.01	.163	.039

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table I.4

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Behavioural Intentions for the Physical Message Conditions (n = 54)

Effect	*F*	*p*	η_p^2
CW BAS: Drive and framing on behavioural intentions			
Drive	0.54	.465	.011
framing	0.48	.490	.010
Drive x framing	0.40	.530	.008
CW BAS: Fun Seeking and framing on behavioural intentions			
Fun Seeking	0.47	.495	.009
framing	1.33	.254	.026
Fun Seeking x framing	1.38	.247	.027
CC BAS: Reward Interest and framing on behavioural intentions			
Reward Interest	< 0.01	.989	< .001
framing	1.51	.225	.029
Reward Interest x framing	1.36	.250	.026
CC BAS: Reward Reactivity and framing on behavioural intentions			
Reward Reactivity	0.37	.546	.007
framing	1.66	.230	.032
Reward Reactivity x framing	1.54	.220	.030
CC BAS: Impulsivity and framing on behavioural intentions			
Impulsivity	< 0.01	.984	< .001
framing	1.44	.236	.028
Impulsivity x framing	1.30	.260	.025
CC Defensive Fight and framing on behavioural intentions			
Defensive Fight	0.83	.367	.016
framing	0.23	.634	.005
Defensive Fight x framing	0.18	.670	.004

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table I.5

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Message Compliance for the Physical Message Conditions (n = 34)

Effect	*F*	*p*	η_p^2
CW BAS: Reward Responsiveness and framing on message compliance			
Reward Responsiveness	1.09	.305	.035
framing	0.01	.908	< .001
Reward Responsiveness x framing	0.01	.926	< .001
CW BAS: Drive and framing on message compliance			
Drive	1.27	.270	.040
framing	0.54	.467	.018
Drive x framing	0.46	.503	.015
CC BAS: Reward Interest and framing on message compliance			
Reward Interest	< 0.01	.970	< .001
framing	0.01	.917	< .001
Reward Interest x framing	0.03	.863	.001
CC BAS: Goal-Drive Persistence and framing on message compliance			
Goal-Drive Persistence	0.96	.335	.031
framing	0.34	.562	.011
Goal-Drive Persistence x framing	0.43	.519	.014
CC BAS: Reward Reactivity and framing on message compliance			
Reward Reactivity	0.57	.456	.019
framing	0.90	.349	.029
Reward Reactivity x framing	0.83	.368	.027
CC BAS: Defensive Fight and framing on message compliance			
Defensive Fight	0.08	.775	.003
framing	0.16	.689	.005
Defensive Fight x framing	0.13	.719	.004
Jackson's BAS and framing on message compliance			
BAS	0.33	.570	.011
framing	2.04	.163	.064
BAS x framing	2.37	.134	.073

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table I.6

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Message Processing for the Physical Message Conditions (RT)

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and framing on processing (*n* = 54)			
FFFS: Fear	0.01	.911	< .001
framing	0.04	.847	.001
FFFS: Fear x framing	0.08	.783	.002
CC FFFS and framing on processing (*n* = 54)			
FFFS	1.49	.228	.029
framing	0.29	.592	.006
FFFS x framing	0.46	.499	.009
CC Panic and framing on processing (*n* = 54)			
Panic	0.10	.752	.002
framing	0.30	.586	.006
Panic x framing	0.20	.660	.004
Jackson’s FFFS and framing on processing (*n* = 54)			
FFFS	0.05	.817	.001
framing	0.07	.787	.001
FFFS x framing	0.05	.833	.001
Jackson’s Fight and framing on processing (*n* = 54)			
Fight	0.81	.371	.016
framing	2.62	.112	.050
Fight x framing	2.51	.115	.049
Jackson’s Flight and framing on processing (*n* = 54)			
Flight	0.90	.346	.018
framing	0.07	.790	.001
Flight x framing	0.10	.759	.002
Jackson’s Freezing and framing on processing (*n* = 54)			
Freezing	0.66	.421	.013
framing	0.19	.668	.004
Freezing x framing	0.28	.600	.006

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table I.7

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Message Effectiveness for the Physical Message Conditions

Effect	F	p	η_p^2
CW FFFS: Fear and framing on message effectiveness (n = 54)			
FFFS: Fear	0.02	.903	< .001
framing	0.27	.604	.005
FFFS: Fear x framing	0.40	.529	.008
CC FFFS and framing on message effectiveness (n = 54)			
FFFS	0.88	.353	.017
framing	0.01	.914	< .001
FFFS x framing	< 0.01	.966	< .001
CC Panic and framing on message effectiveness (n = 54)			
Panic	0.77	.385	.015
framing	0.15	.704	.003
Panic x framing	0.32	.574	.006
Jackson's FFFS and framing on message effectiveness (n = 54)			
FFFS	2.09	.154	.040
framing	0.01	.916	< .001
FFFS x framing	< 0.01	.986	< .001
Jackson's Fight and framing on message effectiveness (n = 54)			
Fight	0.02	.892	< .001
framing	0.05	.830	.001
Fight x framing	0.01	.927	< .001
Jackson's Flight and framing on message effectiveness (n = 54)			
Flight	1.09	.302	.021
framing	0.58	.451	.011
Flight x framing	0.68	.413	.013

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table I.8

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Attitudes for the Physical Message Conditions

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and framing on attitudes (*n* = 54)			
FFFS: Fear	1.45	.234	.028
framing	0.38	.539	.008
FFFS: Fear x framing	0.42	.522	.008
CC FFFS and framing on attitudes (*n* = 54)			
FFFS	1.21	.276	.024
framing	2.04	.160	.039
FFFS x framing	2.06	.158	.039
CC Panic and framing on attitudes (*n* = 54)			
Panic	1.71	.197	.033
framing	0.26	.612	.005
Panic x framing	0.23	.632	.005
Jackson's Fight and framing on attitudes (*n* = 54)			
Fight	0.01	.935	< .001
framing	0.62	.434	.012
Fight x framing	0.74	.394	.015

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table I.9

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Behavioural Intentions for the Physical Message Conditions

Effect	F	p	η_p^2
CW FFFS: Fear and framing on behavioural intentions (n = 54)			
FFFS: Fear	1.17	.284	.023
framing	0.95	.335	.019
FFFS: Fear x framing	1.21	.277	.024
CC FFFS and framing on behavioural intentions (n = 54)			
FFFS	2.34	.133	.045
framing	0.14	.714	.003
FFFS x framing	0.25	.622	.005
CC Panic and framing on behavioural intentions (n = 54)			
Panic	1.37	.248	.027
framing	0.51	.477	.010
Panic x framing	0.74	.394	.015
Jackson's FFFS and framing on behavioural intentions (n = 54)			
FFFS	2.09	.155	.040
framing	< 0.01	.948	< .001
FFFS x framing	0.02	.897	< .001
Jackson's Fight and framing on behavioural intentions (n = 54)			
Fight	0.76	.389	.015
framing	0.14	.714	.003
Fight x framing	0.11	.739	.002
Jackson's Flight and framing on behavioural intentions (n = 54)			
Flight	2.36	.131	.045
framing	0.54	.466	.011
Flight x framing	0.58	.450	.011

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table I.10

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Message Compliance for the Physical Message Conditions

Effect	F	p	η_p^2
CW FFFS: Fear and framing on message compliance (n = 34)			
FFFS: Fear	0.04	.842	.001
framing	2.73	.109	.083
FFFS: Fear x framing	2.61	.116	.080
CC FFFS and framing on message compliance (n = 34)			
FFFS	0.45	.509	.015
framing	0.61	.442	.020
FFFS x framing	0.54	.467	.018
CC Panic and framing on message compliance (n = 34)			
Panic	0.04	.850	.001
framing	0.13	.717	.004
Panic x framing	0.08	.786	.002
Jackson's Fight and framing on message compliance (n = 34)			
Fight	0.04	.847	.001
framing	0.06	.802	.002
Fight x framing	0.04	.851	.001
Jackson's Flight and framing on message compliance (n = 34)			
Flight	0.11	.754	.004
framing	1.76	.195	.055
Flight x framing	1.67	.207	.053
Jackson's Freezing and framing on message compliance (n = 34)			
Freezing	2.31	.139	.071
framing	0.27	.609	.009
Freezing x framing	0.22	.644	.007

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Appendix J

ANOVA Effects: Social Condition

Table J.1

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Message Processing (RT) for the Social Message Conditions

Effect	F	p	η_p^2
CW BAS: Reward Responsiveness and framing on Processing (n = 53)			
Reward Responsiveness	0.30	.589	.006
framing	1.22	.275	.024
Reward Responsiveness x framing	1.13	.294	.022
CW BAS: Drive and framing on Processing (n = 53)			
Drive	1.75	.193	.034
framing	0.12	.732	.002
Drive x framing	0.24	.626	.005
CW BAS: Fun Seeking and framing on Processing (n = 53)			
Fun Seeking	1.15	.290	.023
framing	0.30	.585	.006
Fun Seeking x framing	0.23	.633	.005
CC BAS: Reward Interest and framing on Processing (n = 54)			
Reward Interest	2.80	.101	.053
framing	0.82	.371	.016
Reward Interest x framing	1.05	.311	.020
CC BAS: Goal-Drive Persistence and framing on Processing (n = 54)			
Goal-Drive Persistence	0.02	.890	< .001
framing	0.08	.774	.002
Goal-Drive Persistence x framing	0.06	.807	.001
CC BAS: Impulsivity and framing on Processing (n = 54)			
Impulsivity	0.20	.656	.004
framing	< 0.01	.976	< .001
Impulsivity x framing	< 0.01	.986	< .001
CC Defensive Fight and framing on Processing (n = 54)			
Defensive Fight	0.87	.356	.017
framing	0.45	.504	.009
Defensive Fight x framing	0.60	.444	.012
Jackson's BAS and framing on Processing (n = 54)			
BAS	1.22	.275	.024
framing	0.29	.591	.006
BAS x framing	0.25	.617	.005

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table J.2

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Message Effectiveness for the Social Message Conditions

Effect	F	p	η_p^2
CW BAS: Reward Responsiveness and framing on message effectiveness (n = 53)			
Reward Responsiveness	0.01	.918	< .001
framing	0.07	.792	.001
Reward Responsiveness x framing	0.09	.772	.002
CW BAS: Drive and Framing on message effectiveness (n = 53)			
Drive	0.05	.829	.001
framing	0.04	.846	.001
Drive x framing	0.02	.881	< .001
CW BAS: Fun Seeking and framing on message effectiveness (n = 53)			
Fun Seeking	< 0.01	.950	< .001
framing	0.09	.760	.002
Fun Seeking x framing	0.12	.728	.002
CC BAS: Reward Interest and framing on message effectiveness (n = 54)			
Reward Interest	1.70	.199	.033
framing	0.82	.368	.016
Reward Interest x framing	1.02	.317	.020
CC BAS: Goal-Drive Persistence and framing on message effectiveness (n = 54)			
Goal-Drive Persistence	2.46	.123	.047
framing	2.75	.104	.052
Goal-Drive Persistence x framing	2.63	.111	.050
CC BAS: Reward Reactivity and framing on message effectiveness (n = 54)			
Reward Reactivity	0.25	.622	.005
framing	0.66	.421	.013
Reward Reactivity x framing	0.63	.430	.012
CC BAS: Impulsivity and framing on message effectiveness (n = 54)			
Impulsivity	1.85	.180	.036
framing	1.17	.285	.023
Impulsivity x framing	1.08	.304	.021

Effect	F	p	η_p^2
CC Defensive Fight and framing on message effectiveness (n = 54)			
Defensive Fight	0.04	.843	.001
framing	0.02	.900	< .001
Defensive Fight x framing	0.01	.936	< .001
Jackson's BAS and framing on message effectiveness (n = 54)			
BAS	0.20	.654	.004
framing	0.44	.511	.009
BAS x framing	0.40	.529	.008

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table J.3

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Attitudes for the Social Message Conditions

Effect	*F*	*p*	η_p^2
CW BAS: Reward Responsiveness and framing on attitudes (*n* =53)			
Reward Responsiveness	0.59	.447	.012
Framing	0.14	.710	.003
Reward Responsiveness x framing	0.17	.683	.003
CW BAS: Drive and framing on attitudes (*n* = 53)			
Drive	0.08	.773	.002
framing	0.61	.440	.012
Drive x framing	0.75	.392	.015
CW BAS: Fun Seeking and framing on attitudes (*n* = 53)			
Fun Seeking	0.01	.914	< .001
framing	0.38	.542	.008
Fun Seeking x framing	0.46	.502	.009
CC BAS: Reward Interest and framing on attitudes (*n* = 54)			
Reward Interest	1.13	.298	.022
framing	0.23	.638	.004
Reward Interest x framing	0.22	.634	.004
CC BAS: Reward Reactivity and framing on attitudes (*n* = 54)			
Reward Reactivity	0.12	.731	.002
framing	1.62	.209	.031
Reward Reactivity x framing	1.75	.129	.034
CC BAS: Impulsivity and framing on attitudes (*n* = 54)			
Impulsivity	1.67	.202	.032
framing	1.02	.317	.020
Impulsivity x framing	1.10	.300	.021
CC Defensive Fight and framing on attitudes (*n* = 54)			
Defensive Fight	1.41	.241	.027
framing	0.70	.407	.014
Defensive Fight x framing	0.73	.399	.014
Jackson’s BAS and framing on attitudes (*n* = 54)			
BAS	0.14	.714	.003
framing	0.01	.907	< .001
BAS x framing	0.01	.917	< .001

Table J.4

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Behavioural Intentions for the Social Message Conditions

Effect	*F*	*p*	η_p^2
CW BAS: Reward Responsiveness and framing on behavioural intentions (*n* = 53)			
Reward Responsiveness	1.19	.280	.024
framing	0.05	.826	.001
Reward Responsiveness x framing	0.03	.856	.001
CW BAS: Drive and framing on behavioural intentions (*n* = 53)			
Drive	0.91	.346	.018
framing	0.09	.770	.002
Drive x framing	0.04	.848	.001
CW BAS: Fun Seeking and framing on behavioural intentions (*n* = 53)			
Fun Seeking	0.39	.538	.008
framing	0.02	.886	< .001
Fun Seeking x framing	0.04	.834	.001
CC BAS: Reward Interest and framing on behavioural intentions (*n* = 54)			
Reward Interest	1.09	.301	.021
framing	0.29	.594	.006
Reward Interest x framing	0.19	.661	.004
CC BAS: Reward Reactivity and framing on behavioural intentions (*n* = 54)			
Reward Reactivity	1.72	.196	.033
framing	0.67	.418	.013
Reward Reactivity x framing	0.64	.429	.013
CC BAS: Impulsivity and framing on behavioural intentions (*n* = 54)			
Impulsivity	1.63	.207	.032
framing	1.02	.317	.020
Impulsivity x framing	0.89	.350	.018
CC: Defensive Fight and framing on behavioural intentions (*n* = 54)			
Defensive Fight	0.88	.354	.017
framing	0.14	.709	.003
Defensive Fight x framing	0.08	.784	.002
Jackson's BAS and framing on behavioural intentions (*n* = 54)			
BAS	0.04	.846	.001
framing	0.02	.884	< .001
BAS x framing	0.04	.849	.001

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table J.5

Non-Significant ANOVA Effects of BAS Traits and Framing (Gain-framed vs. Loss-framed) on Message Compliance for the Social Message Conditions

Effect	F	p	η_p^2
CW BAS: Fun Seeking and framing on message compliance (*n* = 34)			
Fun Seeking	2.82	.104	.086
framing	1.15	.293	.037
Fun Seeking x framing	1.46	.237	.006
CC BAS: Reward Interest and framing on message compliance (*n* = 35)			
Reward Interest	0.01	.926	< .001
framing	0.36	.552	.012
Reward Interest x framing	0.23	.638	.017
CC BAS: Reward Reactivity and framing on message compliance (*n* = 35)			
Reward Reactivity	0.02	.886	.001
framing	0.83	.368	.026
Reward Reactivity x framing	0.61	.440	.019
CC BAS: Impulsivity and framing on message compliance (*n* = 35)			
Impulsivity	1.21	.280	.038
framing	0.09	.773	.003
Impulsivity x framing	0.03	.870	.001
CC Defensive Fight and framing on message compliance (*n* = 35)			
Defensive Fight	< 0.01	.957	< .001
framing	0.65	.425	.021
Defensive Fight x framing	0.42	.522	.013
Jackson’s BAS and framing on message compliance (*n* = 35)			
BAS	0.34	.565	.011
framing	0.29	.596	.009
BAS x framing	0.40	.530	.013

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table J.6

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Message Processing (RT) for the Social Message Conditions

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and framing on Processing (*n* = 53)			
FFFS: Fear	< 0.01	.971	< .001
framing	< 0.01	.990	< .001
FFFS: Fear x framing	< 0.01	.949	< .001
CC FFFS and framing on Processing (*n* = 54)			
FFFS	0.14	.713	.003
framing	0.30	.588	.006
FFFS x framing	0.42	.522	.008
CC Panic and framing on Processing (*n* = 54)			
Panic	0.02	.895	< .001
framing	0.39	.535	.008
Panic x framing	0.32	.576	.006
Jackson’s Fight and framing on Processing (*n* = 54)			
Fight	0.26	.616	.005
framing	0.87	.355	.017
Fight x framing	1.03	.315	.020
Jackson’s Flight and framing on Processing (*n* = 54)			
Flight	0.80	.376	.016
framing	< 0.01	.992	< .001
Flight x framing	< 0.01	.972	< .001
Jackson’s Freezing and framing on Processing (*n* = 54)			
Freezing	0.01	.938	< .001
framing	1.55	.218	.030
Freezing x framing	1.74	.193	.034

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table J.7

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Message Effectiveness for the Social Message Conditions

Effect	F	p	η_p^2
CW FFFS: Fear and framing on message effectiveness (n = 53)			
FFFS: Fear	1.55	.219	.031
framing	0.11	.739	.002
FFFS: Fear x framing	0.17	.683	.003
CC FFFS and framing on message effectiveness (n = 54)			
FFFS	0.34	.563	.007
framing	0.64	.429	.013
FFFS x framing	0.61	.437	.012
CC Panic and framing on message effectiveness (n = 54)			
Panic	0.02	.887	< .001
framing	0.31	.583	.006
Panic x framing	0.26	.612	.005
Jackson's FFFS and framing on message effectiveness (n = 54)			
FFFS	0.05	.821	.001
framing	0.02	.881	< .001
FFFS x framing	0.03	.854	.001
Jackson's Flight and framing on message effectiveness (n = 54)			
Flight	.065	.423	.013
framing	0.15	.700	.003
Flight x framing	0.13	.715	.003
Jackson's Freezing and framing on message effectiveness (n = 54)			
Freezing	0.06	.805	.001
framing	0.14	.715	.003
Freezing x framing	0.18	.672	.004

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table J.8

Non-Significant ANOVA Effects of the FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Attitudes for the Social Message Conditions

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and framing on attitudes (*n* = 53)			
FFFS: Fear	0.08	.777	.002
framing	0.71	.404	.014
FFFS: Fear x framing	0.67	.419	.013
CC FFFS and framing on attitudes (*n* = 54)			
FFFS	< 0.01	.985	< .001
framing	0.43	.516	.008
FFFS x framing	0.41	.524	.008
CC Panic and framing on attitudes (*n* = 54)			
Panic	0.07	.792	.001
framing	0.04	.837	.001
Panic x framing	0.07	.787	.001
Jackson's FFFS and framing on attitudes (*n* = 54)			
FFFS	0.01	.924	< .001
framing	0.98	.328	.019
FFFS x framing	0.95	.334	.019
Jackson's Fight and framing on attitudes (*n* = 54)	1.73	.194	.034
Fight	0.18	.674	.004
framing	0.28	.597	.006
Fight x framing			
Jackson's Flight and framing on attitudes (*n* = 54)			
Flight	0.81	.371	.016
framing	0.49	.490	.010
Flight x framing	0.55	.461	.011
Jackson's Freezing and framing on attitudes (*n* = 54)			
Freezing	0.05	.819	.001
framing	2.26	.139	.043
Freezing x framing	2.25	.140	.043

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table J.9

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Behavioural Intentions for the Social Message Conditions

Effect	F	p	η_p^2
CW FFFS: Fear and framing on behavioural intentions (n = 53)			
FFFS: Fear	0.16	.689	.003
framing	0.36	.551	.007
FFFS: Fear x framing	0.47	.497	.009
CC FFFS and framing on behavioural intentions (n = 54)			
FFFS	0.49	.486	.010
framing	0.01	.935	< .001
FFFS x framing	0.02	.881	< .001
CC Panic and framing on behavioural intentions (n = 54)			
Panic	0.30	.586	.006
framing	0.39	.538	.008
Panic x framing	0.33	.568	.007
Jackson's FFFS and framing on behavioural intentions (n = 54)			
FFFS	0.15	.705	.003
framing	0.16	.694	.003
FFFS x framing	0.19	.663	.004
Jackson's Fight and framing on behavioural intentions (n = 54)			
Fight	1.70	.198	.033
framing	0.18	.672	.004
Fight x framing	0.24	.629	.005
Jackson's Flight and framing on behavioural intentions (n = 54)			
Flight	2.40	.159	.039
framing	1.45	.234	.028
Flight x framing	1.40	.242	.027
Jackson's Freezing and framing on behavioural intentions (n = 54)			
Freezing	0.18	.672	.004
framing	0.31	.583	.006
Freezing x framing	0.41	.525	.008

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table J.10

Non-Significant ANOVA Effects of FFFS Traits and Framing (Gain-framed vs. Loss-framed) on Message Compliance for the Social Message Conditions

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and framing on message compliance (*n* = 53)			
FFFS: Fear	0.02	.889	.001
framing	< 0.01	.996	< .001
FFFS: Fear x framing	0.02	.815	.001
CC FFFS and framing on message compliance (*n* = 54)			
FFFS	0.95	.337	.030
framing	0.29	.595	.009
FFFS x framing	0.57	.456	.018
Jackson's FFFS and framing on message compliance (*n* = 54)			
FFFS	0.14	.711	.004
framing	0.17	.685	.005
FFFS x framing	0.10	.751	.003
Jackson's Fight and framing on message compliance (*n* = 54)			
Fight	0.72	.404	.023
framing	0.03	.860	.001
Fight x framing	0.16	.696	.005
Jackson's Flight and framing on message compliance (*n* = 54)			
Flight	0.01	.944	< .001
framing	2.80	.105	.083
Flight x framing	2.53	.122	.075
Jackson's Freezing and framing on message compliance (*n* = 54)			
Freezing	0.18	.673	.006
framing	0.06	.806	.002
Freezing x framing	0.01	.923	< .001

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Appendix K

ANOVA Effects: Mixed Condition on Message Processing

Table K.1

Non-Significant ANOVA Effects of BIS Traits/CARROT and Condition (Social Loss-framed vs. Mixed Messages) on Message Processing (RT)

Effect	F	p	η_p^2
CW BIS and condition on message processing (n = 52)			
BIS	0.63	.433	.013
condition	1.50	.226	.030
BIS x condition	1.84	.181	.037
Jackson's BIS and condition on message processing (n = 52)			
BIS	1.44	.236	.029
condition	0.05	.824	.001
BIS x condition	0.13	.716	.003
CARROT and condition on message processing (n = 52)			
CARROT	0.23	.633	.005
condition	0.39	.534	.008
CARROT x condition	0.62	.435	.013

Note. CW = Carver and White's BIS/ BAS Scales

Appendix L

ANOVA Effects: Mixed Condition on Message Acceptance

Table L.1

Non-Significant ANOVA Effects of BIS Traits/CARROT and Condition (Social Loss-framed vs. Mixed Messages) on Message Effectiveness

Effect	F	p	η_p^2
CW BIS and condition on message effectiveness (n = 52)			
BIS	0.89	.350	.018
condition	3.13	.083	.016
BIS x condition	2.74	.105	.054
CC BIS and condition on message effectiveness (n = 51)			
BIS	0.68	.416	.014
condition	2.11	.153	.043
BIS x condition	1.59	.214	.033
CARROT and condition on message effectiveness (n = 52)			
CARROT	2.77	.103	.055
condition	1.39	.244	.028
CARROT x condition	0.13	.723	.033

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table L.2

Non-Significant ANOVA Effects of BIS Traits/CARROT and Condition (Social Loss-framed vs. Mixed Messages) on Message Attitudes

Effect	F	p	η_p^2
CW BIS and condition on message attitudes (n = 52)			
BIS	2.59	.114	.051
condition	0.24	.624	.005
BIS x condition	0.35	.557	.007
CW BIS: Anxiety and condition on message attitudes (n = 51)			
BIS: Anxiety	2.38	.129	.047
condition	0.19	.667	.004
BIS: Anxiety x condition	0.26	.614	.005
CC BIS and condition on message attitudes (n = 51)			
BIS	2.27	.139	.046
condition	0.33	.566	.007
BIS x condition	0.45	.504	.010
Jackson’s BIS and condition on message attitudes (n = 52)			
BIS	0.01	.927	< .001
condition	1.83	.183	.037
BIS x condition	2.00	.164	.040
CARROT and condition on message attitudes (n = 52)			
CARROT	0.66	.420	.014
condition	0.04	.836	.001
CARROT x condition	2.06	.158	.041

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table L.3

Non-Significant ANOVA Effects of BIS Traits/CARROT and Condition (Social Loss-framed vs. Mixed Messages) on Behavioural Intentions

Effect	F	p	η_p^2
CW BIS and condition on behavioural intentions (n = 52)			
BIS	2.40	.128	.048
condition	1.02	.318	.021
BIS x condition	0.96	.333	.020
CW BIS: Anxiety and condition on behavioural intentions (n = 52)			
BIS: Anxiety	2.13	.151	.042
condition	0.90	.347	.018
BIS: Anxiety x condition	0.81	.374	.016
CC BIS and condition on behavioural intentions (n = 51)			
BIS	0.69	.411	.014
condition	1.21	.271	.026
BIS x condition	1.10	.300	.023
Jackson's BIS and condition on behavioural intentions (n = 52)			
BIS	0.04	.853	.001
condition	1.22	.275	.025
BIS x condition	1.05	.310	.021
CARROT and condition on behavioural intentions (n = 52)			
CARROT	1.08	.304	.022
condition	0.45	.507	.009
CARROT x condition	1.23	.273	.025

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table L.4

Non-Significant ANOVA Effects of BIS Traits/CARROT and Condition (Social Loss-framed vs. Mixed Messages) on Message Compliance

Effect	F	p	η_p^2
CW BIS, condition, and gender on message compliance (n = 36)			
BIS	0.27	.611	.009
condition	0.01	.946	< .001
gender	1.00	.325	.033
BIS x condition x gender	0.39	.761	.039
CW BIS: Anxiety, condition, and gender on message compliance (n = 36)			
BIS: Anxiety	0.39	.536	.013
condition	0.11	.739	.004
gender	2.27	.142	.073
BIS x condition x gender	0.65	.587	.063
CC BIS, condition, and gender on message compliance (n = 35)			
BIS	0.02	.888	.001
condition	0.10	.750	.004
gender	1.36	.253	.046
BIS x condition x gender	0.52	.671	.053
CARROT, condition, and gender on message compliance (n = 36)			
CARROT	0.58	.454	.019
condition	0.18	.673	.006
gender	2.65	.115	.084
CARROT x condition x gender	0.02	.996	.002

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table L.5

Non-Significant ANOVA Effects of BAS Traits and Condition (Social Loss-framed vs. Mixed Messages) on Message Effectiveness

Effect		*F*	*p*	η_p^2
CW BAS: Reward Responsiveness and condition on message effectiveness (*n* = 52)				
	Reward Responsiveness	1.84	.181	.037
	condition	1.31	.258	.027
	Reward Responsiveness x condition	0.98	.328	.020
CW BAS: Drive and condition on message effectiveness (*n* = 52)				
	Drive	1.45	.234	.029
	condition	2.13	.151	.042
	Drive x condition	1.30	.259	.026
CW BAS: Fun Seeking and condition on message effectiveness (*n* = 52)				
	Fun Seeking	< 0.01	.968	< .001
	condition	0.01	.933	< .001
	Fun Seeking x condition	0.08	.785	.002
CC BAS: Goal-Drive Persistence and condition on message effectiveness (*n* = 51)				
	Goal-Drive Persistence	0.89	.351	.019
	condition	1.47	.232	.030
	Goal-Drive Persistence x condition	0.97	.329	.020
CC BAS: Impulsivity and condition on message effectiveness (*n* = 51)				
	Impulsivity	2.20	.145	.045
	condition	0.79	.378	.017
	Impulsivity x condition	0.45	.506	.009
CC Defensive Fight and condition on message effectiveness (*n* = 51)				
	Defensive Fight	0.36	.554	.007
	condition	1.04	.313	.022
	Defensive Fight x condition	0.65	.426	.014
Jackson’s BAS and condition on message effectiveness (*n* = 52)				
	BAS	0.67	.417	.014
	condition	0.29	.591	.006
	BAS x condition	0.43	.517	.009

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table L.6

Non-Significant ANOVA Effects of BAS Traits and Condition (Social Loss-framed vs. Mixed Messages) on Message Attitudes

Effect	F	p	η_p^2
CW BAS: Reward Responsiveness and condition on message attitudes (*n* = 52)			
Reward Responsiveness	< 0.01	.947	< .001
condition	0.19	.665	.004
Reward Responsiveness x condition	0.01	.926	< .001
CW BAS: Drive and condition on message attitudes (*n* = 52)			
Drive	0.19	.663	.004
condition	0.33	.567	.007
Drive x condition	0.46	.503	.009
CW BAS: Fun Seeking and condition on message attitudes (*n* = 52)			
Fun Seeking	0.53	.472	.011
condition	0.01	.920	< .001
Fun Seeking x condition	< 0.01	.968	< .001
CC BAS: Reward Interest and condition on message attitudes (*n* = 51)			
Reward Interest	0.27	.603	.006
condition	< 0.01	.952	< .001
Reward Interest x condition	< 0.01	.967	< .001
CC BAS: Goal-Drive Persistence and condition on message attitudes (*n* = 51)			
Goal-Drive Persistence	0.01	.936	< .001
condition	0.26	.612	.006
Goal-Drive Persistence x condition	0.32	.575	.007
CC BAS: Reward Reactivity and condition on message attitudes (*n* = 51)			
Reward Reactivity	0.24	.629	.005
condition	1.63	.208	.033
Reward Reactivity x condition	1.76	.192	.036
CC BAS: Impulsivity and condition on message attitudes (*n* = 51)			
Impulsivity	0.41	.523	.009
Condition	2.26	.139	.046
Impulsivity x condition	2.54	.117	.051
CC Defensive Fight and condition on message attitudes (*n* = 51)			
Defensive Fight	0.01	.936	< .001
Condition	0.15	.704	.003
Defensive Fight x condition	0.16	.736	.002

Effect	*F*	*p*	η_p^2
Jackson's BAS and condition on message attitudes (*n* = 52)			
BAS	0.03	.868	.001
condition	0.43	.514	.009
BAS x condition	0.39	.533	.008

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table L.7

Non-Significant ANOVA Effects of BAS Traits and Condition (Social Loss-framed vs. Mixed Messages) on Behavioural Intentions

Effect		F	p	η_p^2
CW BAS: Reward Responsiveness and condition on behavioural intentions (n = 52)				
	Reward Responsiveness	0.07	.798	.001
	condition	0.44	.512	.009
	Reward Responsiveness x condition	0.55	.460	.011
CW BAS: Drive and condition on behavioural intentions (n = 52)				
	Drive	< 0.01	.977	< .001
	condition	0.45	.506	.009
	Drive x condition	0.66	.421	.014
CW BAS: Fun Seeking and condition on behavioural intentions (n = 52)				
	Fun Seeking	0.65	.425	.013
	condition	0.09	.765	.002
	Fun Seeking x condition	0.16	.695	.003
CC BAS: Reward Interest and condition on behavioural intentions (n = 51)				
	Reward Interest	0.15	.704	.003
	condition	0.03	.875	.001
	Reward Interest x condition	0.08	.785	.002
CC BAS: Goal-Drive Persistence and condition on behavioural intentions (n = 51)				
	Goal-Drive Persistence	1.02	.319	.021
	condition	0.13	.721	.003
	Goal-Drive Persistence x condition	0.25	.621	.005
CC BAS: Reward Reactivity and condition on behavioural intentions (n = 51)				
	Reward Reactivity	0.17	.683	.004
	condition	< 0.01	.998	< .001
	Reward Reactivity x condition	0.01	.937	< .001
CC BAS: Impulsivity and condition on behavioural intentions (n = 51)				
	Impulsivity	0.94	.338	.020
	condition	2.36	.132	.048
	Impulsivity x condition	2.15	.150	.044

Effect	F	p	η_p^2
CC Defensive Fight and condition on behavioural intentions (n = 51)			
Defensive Fight	0.23	.632	.005
condition	0.00	.996	< .001
Defensive Fight x condition	0.35	.558	.007
Jackson's BAS and condition on behavioural intentions (n = 52)			
BAS	0.21	.650	.004
condition	0.15	.699	.003
BAS x condition	0.21	.653	.004

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table L.8

Non-Significant ANOVA Effects of BAS Traits and Condition (Social Loss-framed vs. Mixed Messages) on Message Compliance

Effect	F	p	η_p^2
CW BAS: Reward Responsiveness, condition, and gender on message compliance (*n* = 36)			
Reward Responsiveness	0.01	.936	< .001
condition	0.37	.550	.012
gender	0.18	.679	.006
Reward Responsiveness x condition x gender	0.14	.872	.009
CW BAS: Drive, condition, and gender on message compliance (*n* = 36)			
Drive	0.49	.490	.017
condition	0.51	.482	.017
gender	0.18	.672	.006
Drive x condition x gender	0.37	.694	.025
CW BAS: Fun Seeking, condition, and gender on message compliance (*n* = 36)			
Fun Seeking	1.08	.307	.036
condition	0.07	.797	.002
gender	0.93	.344	.031
Fun Seeking x condition x gender	0.87	.428	.057
CC BAS: Reward Interest, condition, and gender on message compliance (*n* = 35)			
Reward Interest	0.28	.603	.010
condition	0.35	.557	.012
gender	0.10	.750	.004
Reward Interest x condition x gender	0.04	.964	.003
CC BAS: Goal-Drive Persistence, condition, and gender on message compliance (*n* = 35)			
Goal-Drive Persistence	< 0.01	.954	< .001
condition	0.03	.870	.001
gender	0.37	.549	.013
Goal-Drive Persistence x condition x gender	0.35	.710	.024
CC BAS: Reward Reactivity, condition, and gender on message compliance (*n* = 35)			
Reward Reactivity	< 0.01	.963	< .001
condition	0.06	.816	.002
gender	0.15	.702	.005
Reward Reactivity x condition x gender	0.01	.992	.001

Effect	F	p	η_p^2
CC BAS: Impulsivity, condition, and gender on message compliance (n = 35)			
Impulsivity	1.19	.284	.041
condition	0.14	.714	.005
gender	0.05	.831	.002
Impulsivity x condition x gender	0.02	.979	.002
CC Defensive Fight, condition, and gender on message compliance (n = 35)			
Defensive Fight	0.06	.809	.002
condition	0.91	.349	.031
gender	0.52	.477	.018
Defensive Fight x condition x gender	0.50	.611	.035
Jackson's BAS, condition, and gender on message compliance (n = 36)			
BAS	0.79	.383	.026
condition	0.14	.713	.005
gender	0.50	.487	.017
BAS x condition x gender	0.41	.667	.028

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table L.9

Non-Significant ANOVA Effects of FFFS Traits and Condition (Social Loss-framed vs. Mixed Messages) on Message Effectiveness

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and condition on message effectiveness (*n* = 52)			
FFFS: Fear	0.03	.868	.001
condition	1.22	.275	.025
FFFS: Fear x condition	0.89	.360	.017
Jackson's FFFS and condition on message effectiveness (*n* = 52)			
FFFS	1.16	.286	.024
condition	1.54	.221	.031
FFFS x condition	1.25	.269	.025
Jackson's Fight and condition on message effectiveness (*n* = 52)			
Fight	0.19	.661	.004
condition	1.94	.170	.039
Fight x condition	1.41	.242	.028
Jackson's Flight and condition on message effectiveness (*n* = 52)			
Flight	2.29	.137	.045
condition	1.44	.236	.029
Flight x condition	1.12	.295	.023
Jackson's Freezing and condition on message effectiveness (*n* = 52)			
Freezing	0.31	.581	.006
condition	0.33	.569	.007
Freezing x condition	0.15	.700	.003

Note. CW = Carver and White's BIS/ BAS Scales

Table L.10

Non-Significant ANOVA Effects of FFFS Traits and Condition (Social Loss-framed vs. Mixed Messages) on Message Attitudes

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and condition on message attitudes (*n* = 52)			
FFFS: Fear	1.35	.251	.027
condition	0.26	.613	.005
FFFS: Fear x condition	0.41	.527	.008
CC FFFS and condition on message attitudes (*n* = 52)			
FFFS	1.66	.230	.033
condition	0.33	.570	.007
FFFS x condition	0.45	.504	.009
CC Panic and condition on message attitudes (*n* = 51)			
Panic	2.74	.105	.055
condition	2.05	.159	.042
Panic x condition	2.76	.103	.055
Jackson's Flight and condition on message attitudes (*n* = 52)			
Flight	0.41	.523	.009
condition	0.16	.688	.003
Flight x condition	0.22	.638	.005
Jackson's Freezing and condition on message attitudes (*n* = 52)			
Freezing	0.81	.371	.017
condition	0.21	.649	.004
Freezing x condition	0.14	.711	.003

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table L.11

Non-Significant ANOVA Effects of FFFS Traits and Condition (Social Loss-framed vs. Mixed Messages) on Behavioural Intentions

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and condition on behavioural intentions (*n* = 52)			
FFFS: Fear	1.45	.234	.029
condition	0.85	.362	.017
FFFS: Fear x condition	0.78	.381	.016
CC FFFS and condition on behavioural intentions (*n* = 52)			
FFFS	1.13	.293	.023
condition	0.08	.781	.002
FFFS x condition	0.03	.869	.001
CC Panic and condition on behavioural intentions (*n* = 51)			
Panic	1.91	.174	.039
condition	2.00	.164	.041
Panic x condition	1.98	.166	.040
Jackson’s FFFS and condition on behavioural intentions (*n* = 52)			
FFFS	2.76	.103	.054
condition	0.62	.435	.013
FFFS x condition	0.52	.475	.011
Jackson’s Fight and condition on behavioural intentions (*n* = 52)			
Fight	0.26	.614	.005
condition	2.26	.140	.045
Fight x condition	1.88	.177	.038
Jackson’s Flight and condition on behavioural intentions (*n* = 52)			
Flight	0.08	.781	.002
condition	0.01	.931	< .001
Flight x condition	< 0.01	.991	< .001
Jackson’s Freezing and condition on behavioural intentions (*n* = 52)			
Freezing	< 0.01	.997	< .001
condition	0.02	.901	< .001
Freezing x condition	0.06	.802	.001

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table L.12

Non-Significant ANOVA Effects of FFFS Traits and Condition (Social Loss-framed vs. Mixed Messages) on Message Compliance

Effect	F	p	η_p^2
CW FFFS: Fear, condition, and gender on message compliance (*n* = 36)			
FFFS: Fear	0.11	.748	.004
condition	0.26	.617	.009
gender	< 0.01	.952	< .001
FFFS: Fear x condition x gender	0.02	.981	.001
CC FFFS, condition, and gender on message compliance (*n* = 36)			
FFFS	0.57	.455	.019
condition	0.02	.902	.001
gender	0.03	.863	.001
FFFS x condition x gender	0.03	.973	.002
CC Panic, condition, and gender on message compliance (*n* = 35)			
Panic	0.12	.731	.004
condition	3.39	.076	.108
gender	0.46	.504	.016
Panic x condition x gender	0.58	.567	.040
Jackson's Fight, condition, and gender on message compliance (*n* = 36)			
Fight	0.37	.548	.013
condition	0.06	.808	.002
gender	0.43	.519	.014
Fight x condition x gender	0.13	.876	.009
Jackson's Flight, condition, and gender on message compliance (*n* = 36)			
Flight	0.86	.362	.029
condition	0.08	.782	.003
gender	0.92	.346	.031
Flight x condition x gender	0.16	.851	.011
Jackson's Freezing, condition, and gender on message compliance (*n* = 36)			
Freezing	0.34	.562	.012
condition	0.01	.944	< .001
gender	1.13	.296	.038
Freezing x condition x gender	0.21	.811	.014

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Appendix M

Gender Differences on Self-report FFFS Scales

Table M.1

Gender Differences on Self-report FFFS Scales

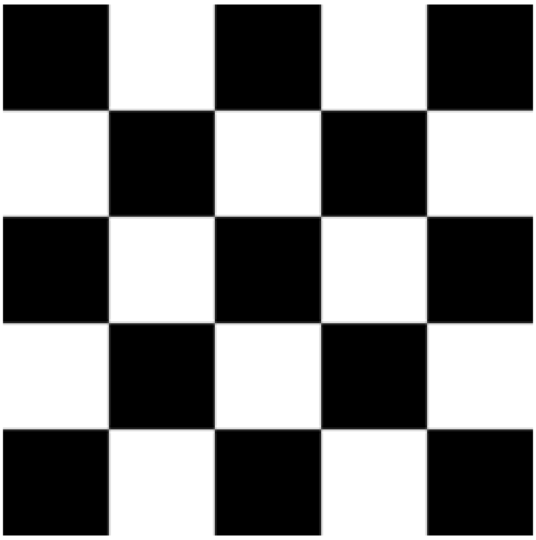
Variable	*n*	*M (SD)*	*t*	*p*	95% CI
CW FFFS: Fear					
Male	35	2.56 (0.64)			
Female	97	3.01 (0.50)	-4.27	< .001	-0.66, -0.24
CC FFFS					
Male	35	1.79 (0.49)			
Female	97	2.32 (0.53)	-5.06	< .001	-0.72, -0.32
Jackson’s FFFS					
Male	35	2.69 (0.30)			
Female	98	2.87 (0.40)	-2.48	.014	-0.33, -0.04
Jackson’s Flight					
Male	35	2.58 (0.56)			
Female	98	2.94 (0.41)	-4.03	< .001	-0.54, -0.18
Jackson’s Fight					
Male	35	3.09 (0.58)			
Female	98	2.50 (0.66)	4.70	< .001	0.34, 0.84
Jackson’s Freezing					
Male	35	2.78 (0.66)			
Female	98	3.29 (0.67)	-3.90	< .001	-0.77, 0.25

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper RST-PQ; J5 = Jackson-5 Scales; CI = Confidence Interval

Appendix N

Sample of Picture and Checkerboard Stimuli

Picture sample #1:

Checkerboard image:	Positive image:
	
Negative image:	Neutral image:
	

Note. Each image scaled to 7 x 7cm, as presented to the participants one by one in the centre of the computer screen

Picture sample #2:

	Positive image: 
Negative image: 	Neutral image: 

Appendix O

Male ERP results [79]

[79] A total of 9 males (*M*age = 21.18, *SD* = 2.58) were included in the following analyses. The majority of those males (n = 6; 55.6%) reported regularly driving 1-10km/hr over the posted speed limit, with one (11.1%) participant reporting regularly driving 10-20km/hr over the posited limit. The remaining three (33.3%) males reported regularly driving at or below the recommended posted speed limit.

Psychophysiological data: Valence effects

A series of 3 (picture valence category: negative, positive, neutral) x 4 (electrode site: Fz, Cz, Pz, Oz) repeated measures ANOVAs were first undertaken to examine message processing via three ERP components: N100, N200, and P300, for the male (n = 9) subsample.

N100. Mauchly's test of Sphericity revealed that this assumption had been breached for electrode location, χ^2 (5) = 18.55, p = .003 and thus, the Greenhouse-Geisser correction was applied to electrode location (ε = .44). There was a significant main effect of electrode location, F(1.33. 10.65) = 3.07, p = .047, η_p^2 = .278. However, there was no significant main effect of valence, F(2, 16) = 1.20, p = .326, η_p^2 = .131.

There was a significant valence x electrode location interaction on N100, F(6, 48) = 5.37, p < .001, η_p^2 = .402. For the Cz electrode, the pairwise comparison was significant between the negative and positive stimuli, M = -0.92, p = .038, 95% CI [-1.79, -0.54], indicating a greater N100 mean amplitude on presentation of the negative images than the positive images. There were no other significant valence pairwise comparisons for the Cz or Fz sites. Since the interaction graph indicated that the N100 was not evident at either the Pz or Oz sites (i.e., as indicated by the zero/ positive microvolts for the picture stimuli at these two electrode locations; see Figure O.1), comparisons were not interpreted for these two electrode locations.

N200. There was no significant main effect of valence, F(2, 16) = 0.59, p = .564, η_p^2 = .069, nor significant main effect of electrode, F(3, 24) = 1.38, p = .272, η_p^2 = .147. The valence x electrode interaction also did not reach significance, F(6, 48) = 1.51, p = .194, η_p^2 = .159. Figure O.2 presents picture processing (as measured by the N200 amplitude) as a function of valence and electrode location.

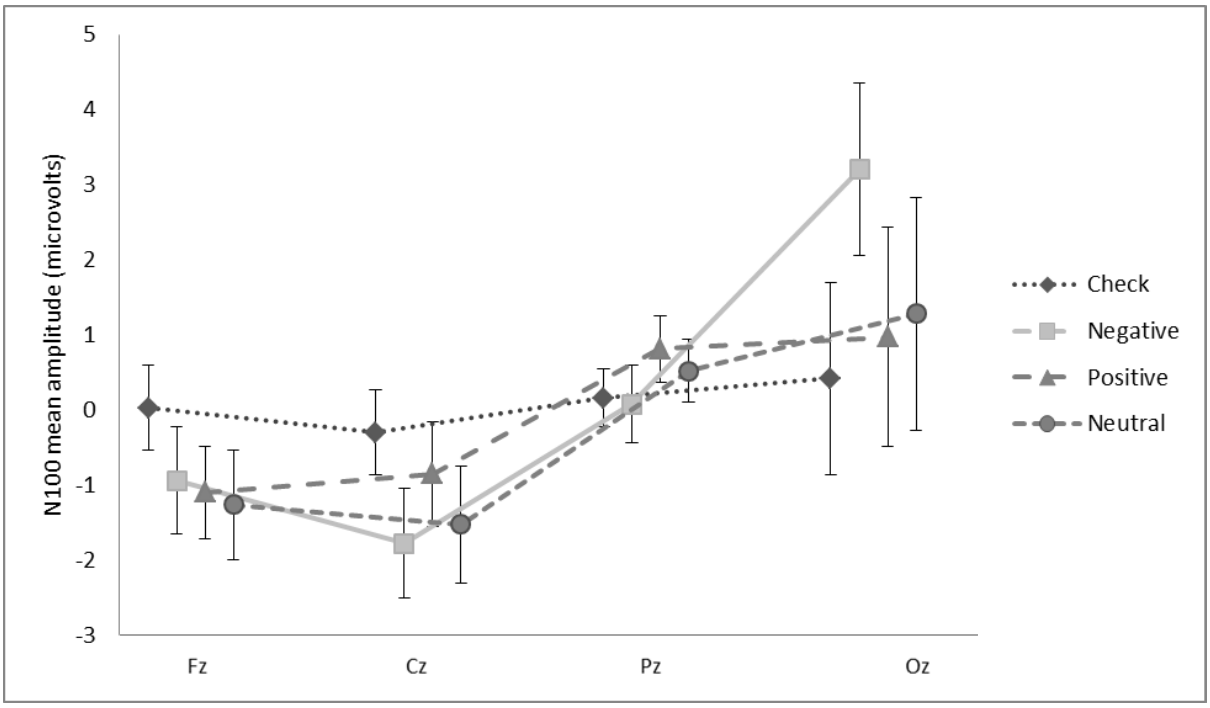


Figure O.1. Picture processing (as measured by the N100 amplitude) as a function of valence and electrode location for male participants. Error bars represent 1 standard error.

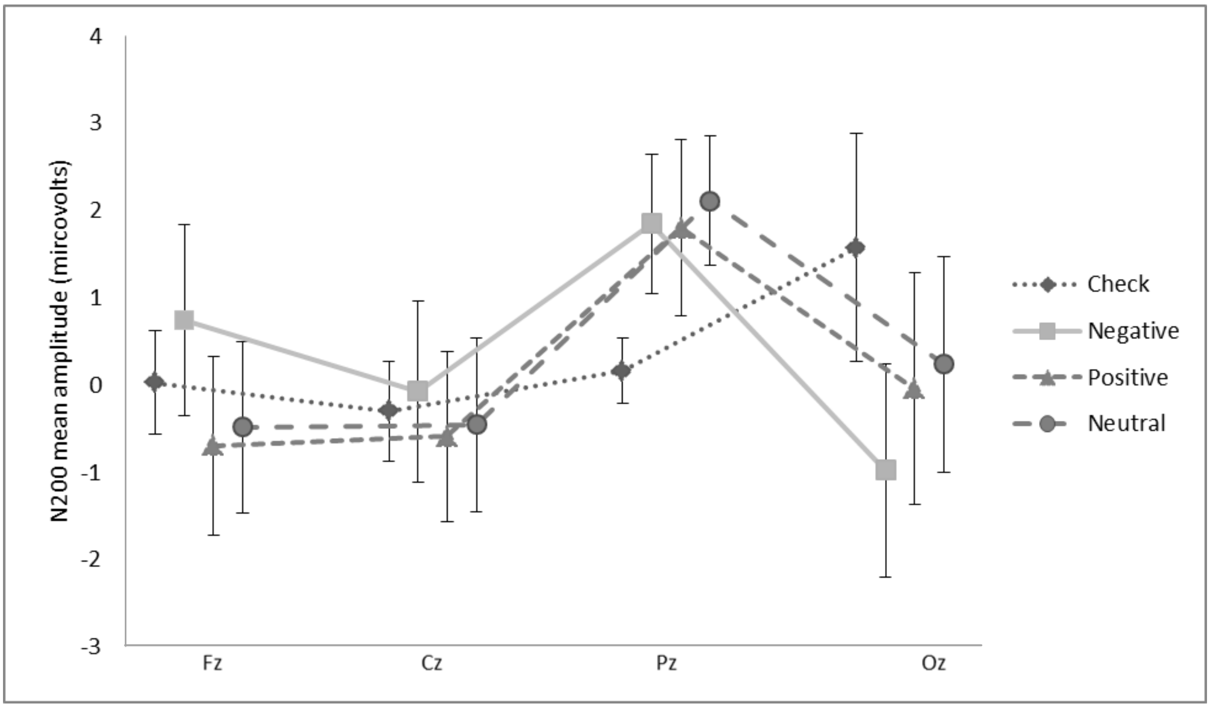


Figure O.2. Picture processing (as measured by the N200 amplitude) as a function of valence and electrode location for male participants. Error bars represent 1 standard error.

P300. Mauchly's test of Sphericity revealed that this assumption had been breached for electrode location, χ^2 (5) = 13.48, p = .021 and thus, the Greenhouse-Geisser correction was applied to electrode location (ε = .51). There was no significant main effect of valence, F(2,16) = 1.13, p = .347, η_p^2 = .124 or electrode location, F(1.53, 12.25) = 2.52, p = .129, η_p^2 = .240. The valence x electrode interaction also failed to reach significance, F(6, 48) = 0.84, p = .546, η_p^2 = .095. Figure O.3 presents picture processing (as measured by the P300 amplitude) as a function of valence and electrode location.

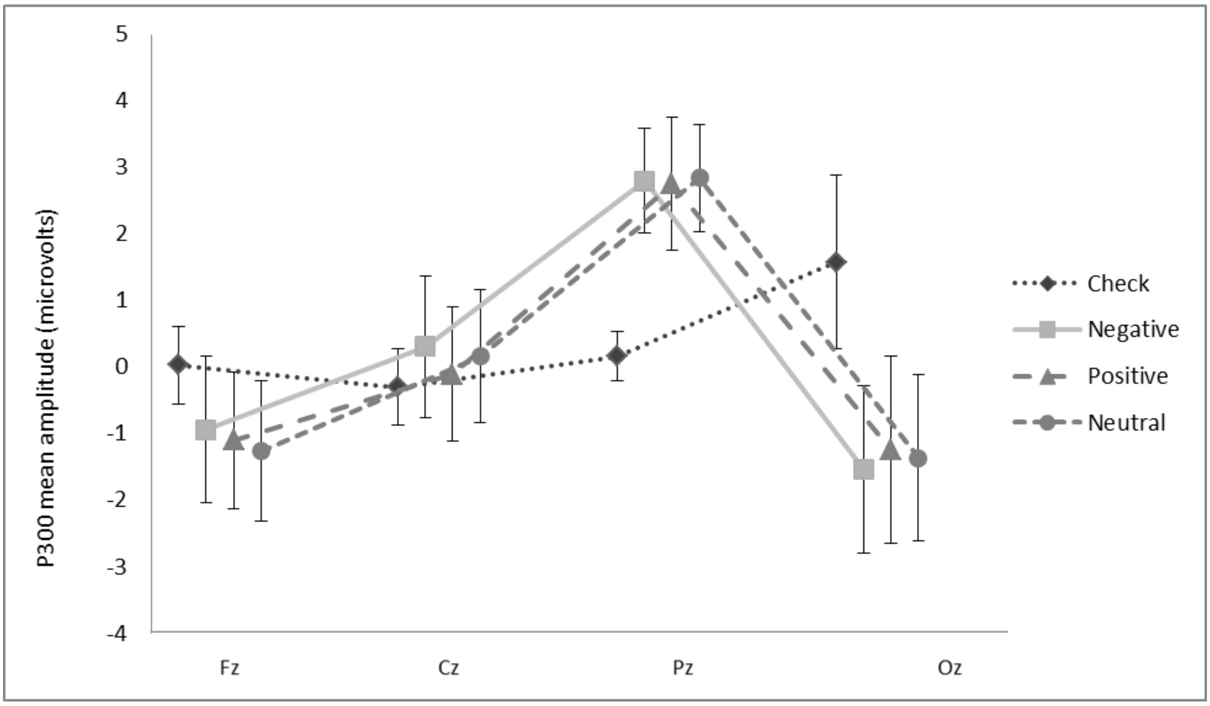


Figure O.3. Picture processing (as measured by the P300 amplitude) as a function of valence and electrode location for male participants. Error bars represent 1 standard error.

Psychophysiological data: RST trait effects

A series of one-way repeated measures ANOVAs were undertaken to test the effects of the individual RST traits on picture processing (ERP), as a function of valence category (controlling for differences in ERP checkerboard stimuli). The significant findings (p < .05) are presented, followed by the findings that approached significance (p < .10), in Tables O.1 and O.2, respectively.

Table O.1

Significant ANOVA Effects of RST Traits and Valence on Picture Processing (ERP Response) for Males (n = 9)

Effect		F	p	η_p^2
Fz N100				
CW BAS: Fun Seeking and valence on processing				
	Fun Seeking	0.02	.893	.003
	Valence	4.19	.037	.374
	Fun Seeking x valence	4.77	.026	.405
CC BIS and valence on processing				
	BIS	1.58	.249	.185
	Valence	8.01	.005	.534
	BIS x valence	8.42	.004	.546
CzN100				
CC Defensive Fight and valence on processing				
	Defensive Fight	0.63	.455	.082
	Valence	5.43	.018	.437
	Defensive Fight x valence	4.70	.027	.402
CW BIS and valence on processing				
	BIS	0.76	.402	.102
	Valence	4.52	.031	.392
	BIS x valence	5.27	.020	.429
CW BIS: Anxiety and valence on processing				
	BIS: Anxiety	0.33	.585	.045
	Valence	3.11	.076	.307
	BIS: Anxiety x valence	4.08	.040	.363
Fz N200				
CW BAS: Drive and valence on processing				
	Drive	1.38	.278	.165
	Valence	5.23	.020	.427
	Drive x valence	4.89	.025	.411
Jackson's Freeze and valence on processing				
	Freeze	<0.01	.970	.000
	Valence	4.45	.032	.389
	Freeze x valence	3.97	.043	.362

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table O.2

ANOVA Trend Effects (p < .1) of RST Traits and Valence on Picture Processing (ERP Response) for Males (n = 9)

Effect		F	p	η_p^2
<u>Fz N100</u>				
CW BAS: Reward Responsiveness and valence on processing				
	Reward Responsiveness	0.01	.896	.003
	Valence	2.91	.088	.293
	Reward Responsiveness x valence	3.04	.080	.303
Jackson's BAS and valence on processing				
	BAS	0.71	.427	.092
	Valence	3.00	.082	.300
	BAS x valence	3.18	.072	.313
<u>CzN100</u>				
CC Impulsivity and valence on processing				
	Impulsivity	0.17	.693	.024
	Valence	4.48	.031	.390
	Impulsivity x valence	3.55	.057	.336
CW FFFS: Fear and valence on processing				
	FFFS: Fear	0.37	.561	.051
	Valence	3.11	.076	.307
	FFFS: Fear x valence	3.67	.052	.344
<u>FzN200</u>				
CC Defensive Fight and valence on processing				
	Defensive Fight	0.22	.656	.030
	Valence	2.79	.096	.285
	Defensive Fight x valence	2.89	.089	.292
CC BIS and valence on processing				
	BIS	0.18	.689	.024
	Valence	2.85	.092	.289
	BIS x valence	2.77	.097	.283
<u>CzN200</u>				
Jackson's Freeze and valence on processing				
	Freeze	2.22	.180	.271
	Valence	3.05	.079	.304
	Freeze x valence	2.82	.094	.287

Effect	*F*	*p*	η_p^2
Pz P300			
Jackson's FFFS and valence on processing			
FFFS	1.64	.241	.190
Valence	2.80	.095	.286
FFFS x valence	2.91	.088	.294

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

N100: Fz electrode. There was a significant CW BAS: Fun Seeking x valence interaction, with a large effect size. However, the linear regression revealed that there were no significant partial correlations between CW BAS: Fun Seeking and the N100 response for the negative stimuli, $r = .257$, $p = .506$, for the positive stimuli, $r = 226$, $p = .402$, or for the neutral stimuli, $r = .386$, $p = .305$. The findings also revealed that the CW BAS: Reward Responsiveness x valence and Jackson's BAS x valence interactions also approached significance, with moderate effect sizes. For these three BAS traits, the direction of means indicated that higher BAS scores lead to a more pronounced N100 for the neutral images only. There was also a significant CC BIS x valence interaction, with the size of the observed effect large. The linear regression revealed a significant partial correlation between CC BIS and pre-attention (N100) towards the positive images, $r = .833$, $p = .005$, accounting for 69.4% of the variance. The simple slopes graph showed that lower CC BIS scores were associated with greater pre-attention towards the positive images (see Figure O.4). There was no significant associations for the negative images, $r = .297$, $p = .438$ or for the neutral images, $r = .073$, $p = .481$.

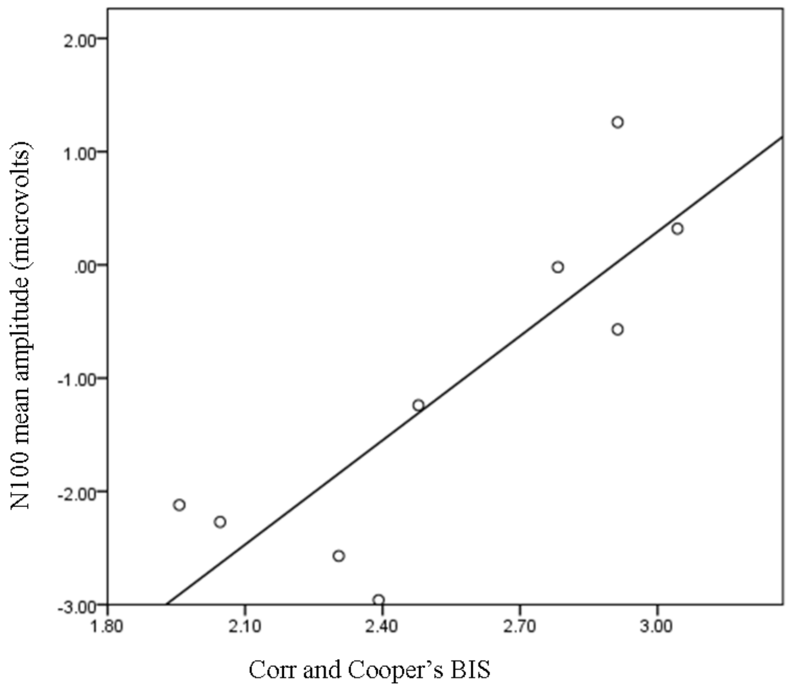


Figure O.4. Partial correlation of CC BIS and the N100 mean amplitude for positive images.

N100: Cz electrode. There was a significant CC Defensive Fight x valence interaction, with the linear regression revealing a significant partial correlation between CC Defensive Fight and the N100 response towards the positive images, $r = .705$, $p = .034$, accounting for 49.7% of the variance. The simple slopes graph showed that individuals with higher CC Defensive Fight showed greater pre-attention towards the positive images (see Figure O.5). There was no significant associations for the negative images, $r = .465$, $p = .208$ or for the neutral images, $r = .322$, $p = .397$. The CC BAS: Impulsivity x valence interaction approached significance, with the size of the observed effect moderate and the direction of means similar to that of CC Defensive Fight, consistent with expectations.

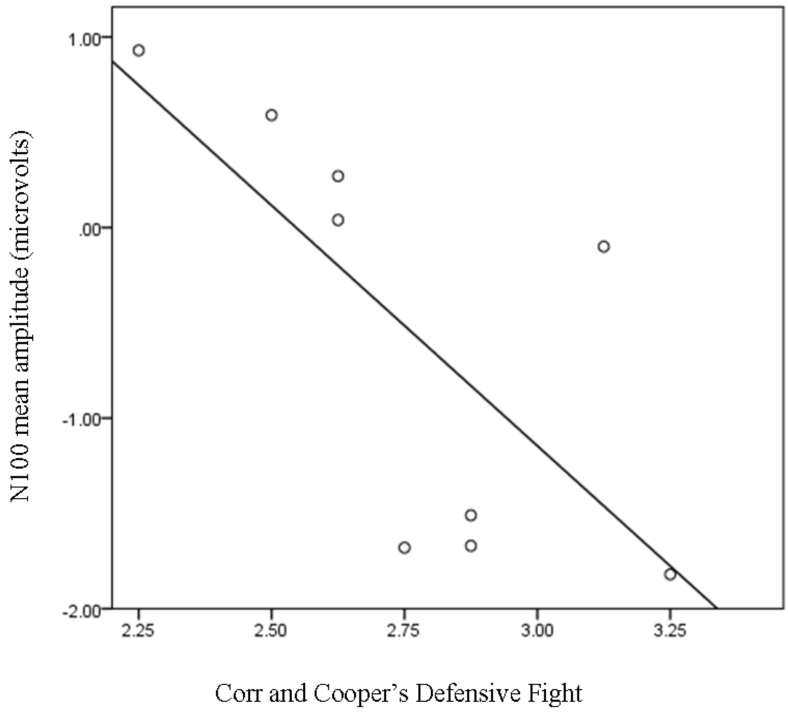


Figure O.5. Partial correlation of CC Defensive Fight and the N100 mean amplitude for positive images.

The findings also revealed a significant CW BIS x valence interaction, with the linear regression revealing a significant partial correlation between CW BIS and the N100 response towards the neutral images, r = .677, p = .045, accounting for 45.8% of the variance. The simple slopes graph showed that higher CW BIS scores were associated with greater pre-attention of the neutral images (see Figure O.6). There was no significant associations for the positive images, r = .322, p = .397, or for the negative images, r = .176, p = .650. The findings also revealed that the CW BIS: Anxiety x valence interaction was significant, while the interaction between CW FFFS: Fear x valence approached significance, with the size of the observed effects moderate. There were no significant partial correlations between the CW BIS: Anxiety traits and valence images nor between the CW FFFS: Fear traits and valence images, suggesting that the significant CW BIS finding reflects a combination of the anxiety and fear responses rather than reflecting independent anxiety and fear responses.[80]

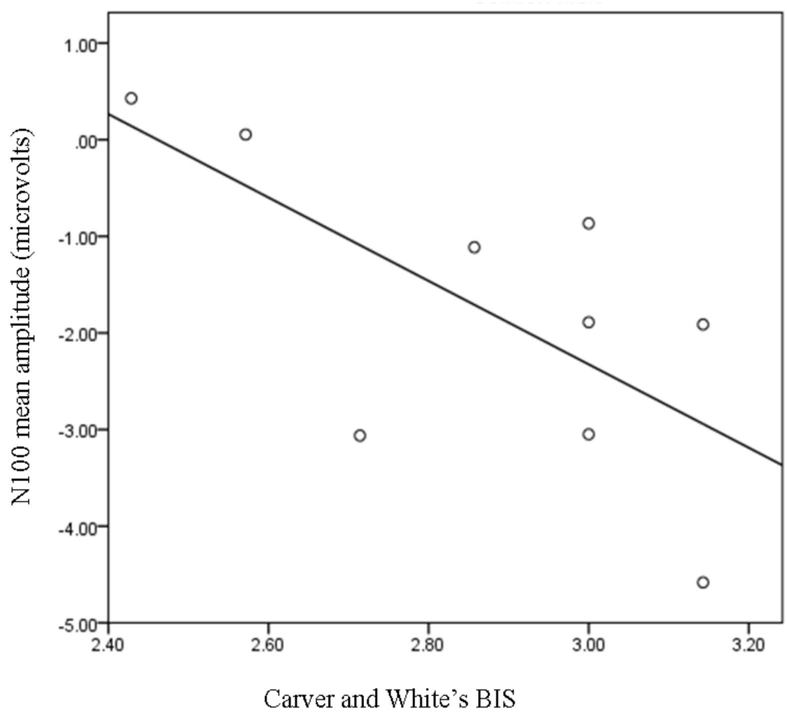


Figure O.6. Partial correlation of CW BIS and the N100 mean amplitude for neutral images.

N200: Fz electrode. There was a significant CW BAS: Drive x valence interaction, with the size of the observed effect large. The liner regression revealed a significant partial correlation between CW BAS: Drive and the N200 response towards the neutral images, r = .692, p = .039, accounting for 47.9% of the variance. The simple slopes graphs showed that individuals with lower CW BAS: Drive scores demonstrated greater attention towards the neutral images (see Figure O.7). There were no significant partial correlations for the positive images, r = .114, p = .770, as predicted, nor the negative images, r = .230, p = .550. The findings also revealed that the CC Defensive Fight x valence interaction approached significance, with a moderate effect size.

[80] CW BIS: Anxiety and CW FFFS: Fear make-up the total CW BIS scale.

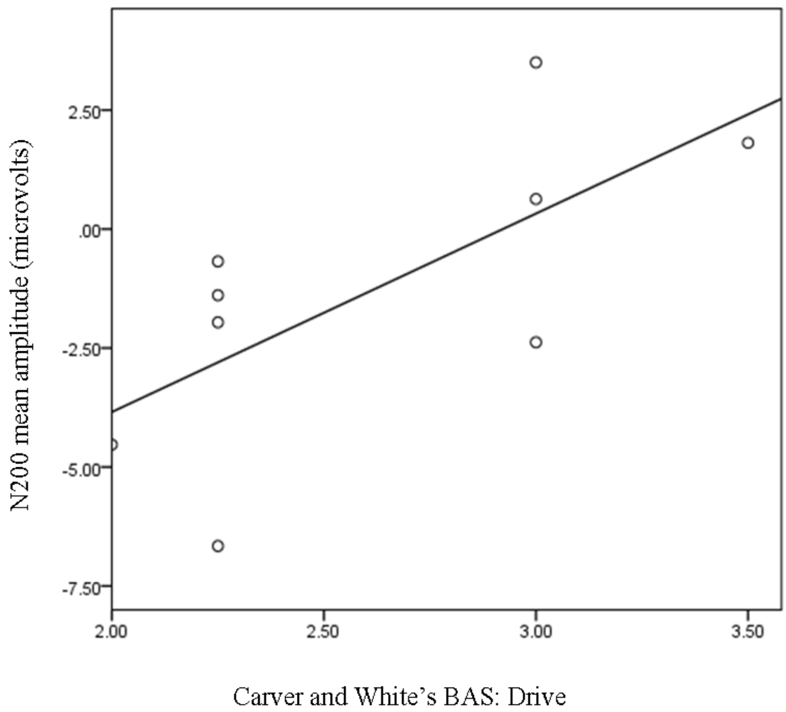


Figure O.7. Partial correlation of CW BAS: Drive and the N200 mean amplitude for neutral images.

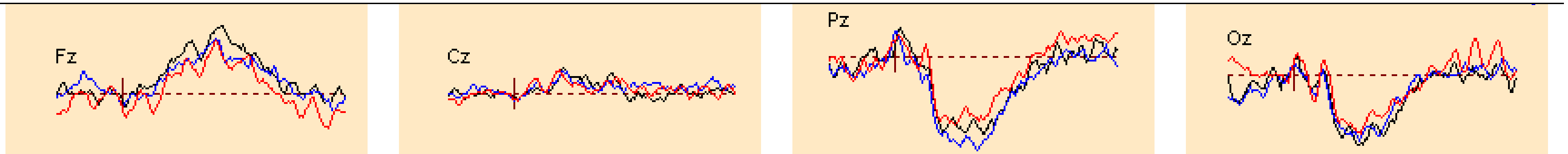
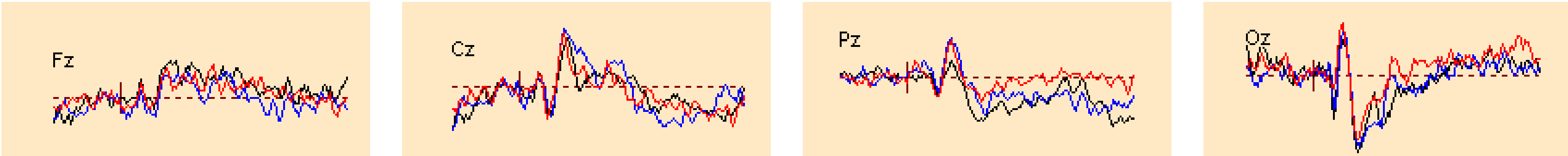
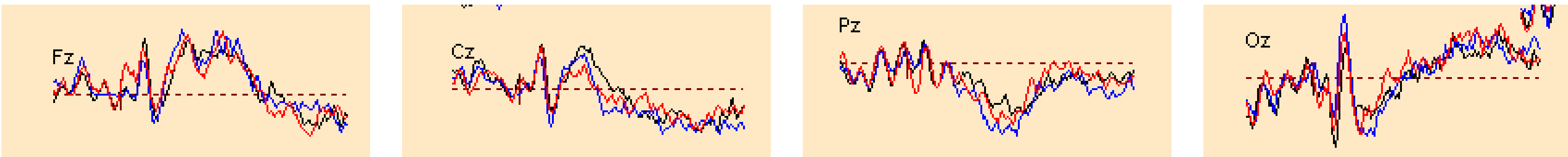
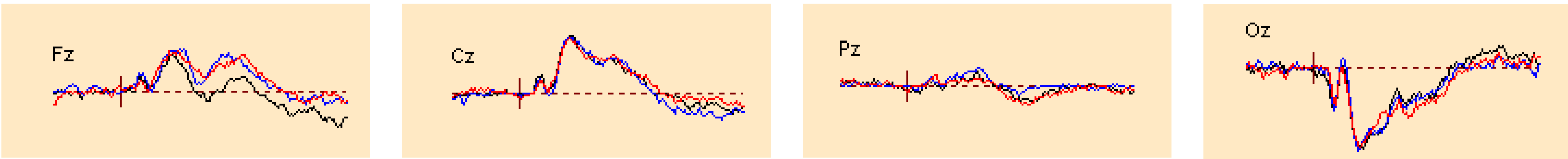
There was a significant Jackson's Freeze x valence interaction, with a moderate effect size. However, the linear regressions revealed no significant partial correlations between Jackson's Freeze and negative images, r = .130, p = .118, between Jackson's Freeze and positive images, r = 202, p = .468, or between Jackson's Freeze and neutral images, r = 356, p = .347. The CC BIS x valence interaction also approached significance, with the size of the observed effect moderate.

N200: Cz electrode. The interaction between Jackson's Freeze and valence approached significance, with a moderate effect. Inconsistent with expectations, however, there were no significant BAS nor FFFS trait x valence interactions on attention (as assessed via the N200).

P300: Pz electrode. The interaction between Jackson's FFFS and valence approached significance, with the size of the observed effect moderate. There were no significant BAS nor FFFS trait x valence interactions on processing (as assessed via the P300), which was inconsistent with the predictions.

Appendix P

Individual Participant ERP Grand Average Waveforms

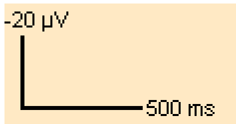
Participant	Electrode site
1	
2	
3	
4	

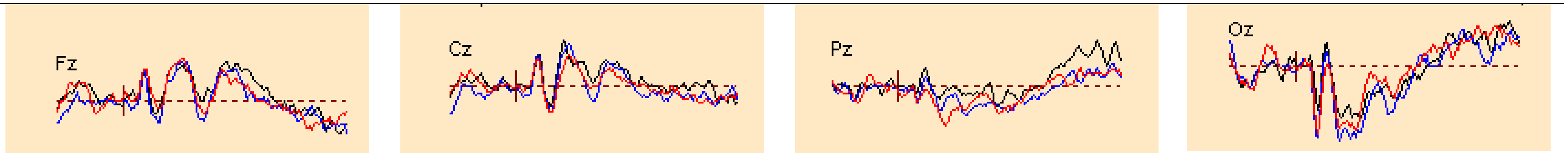
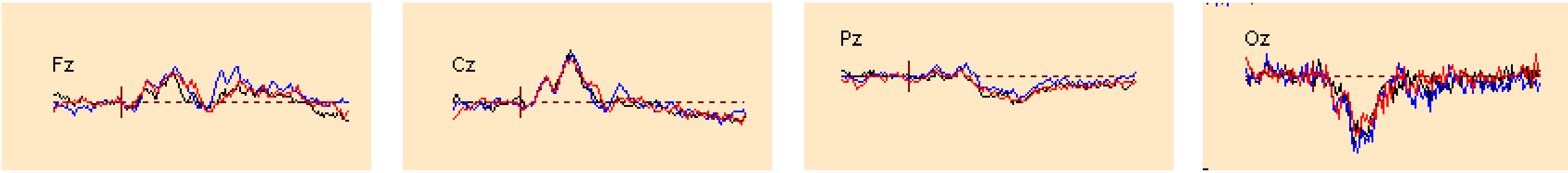
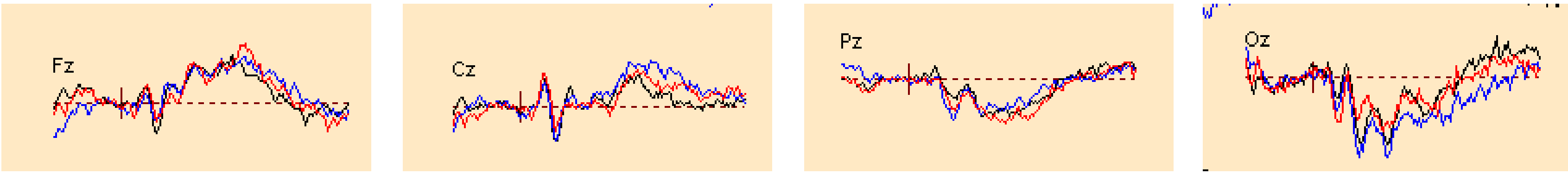
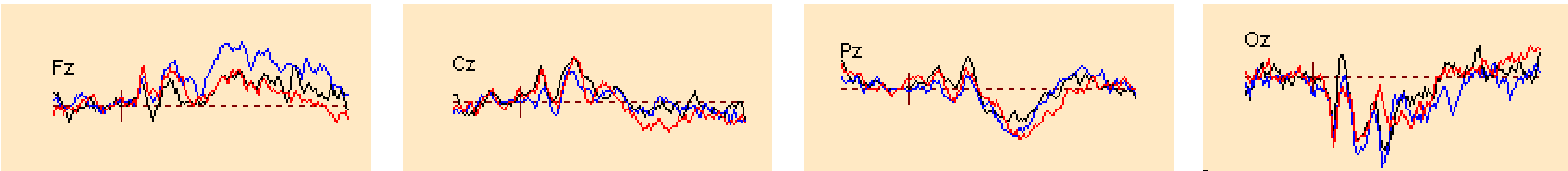
Picture stimuli:

Positive

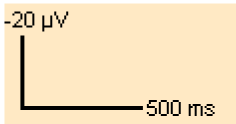
Negative

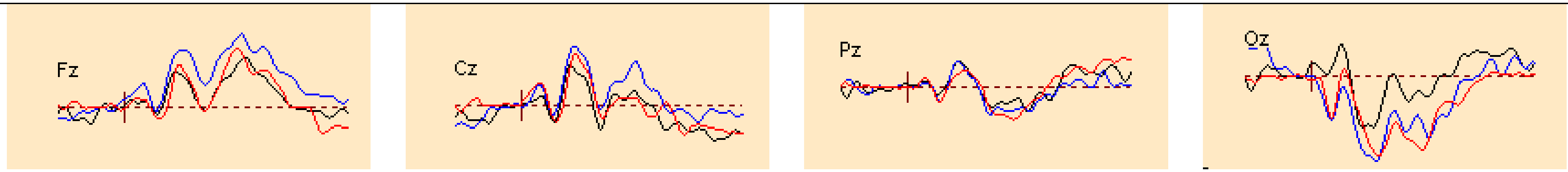
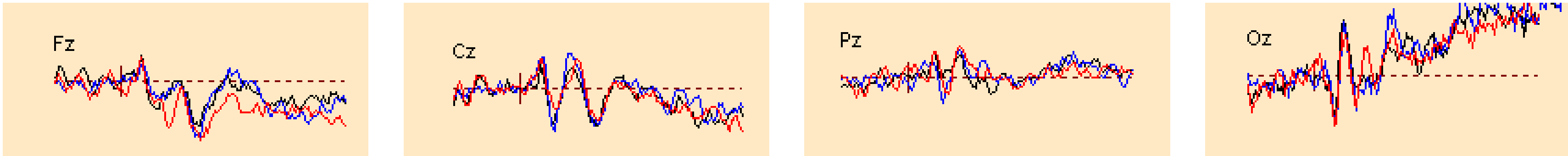
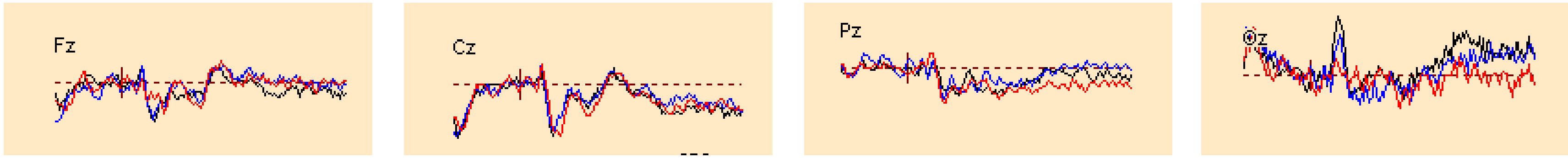
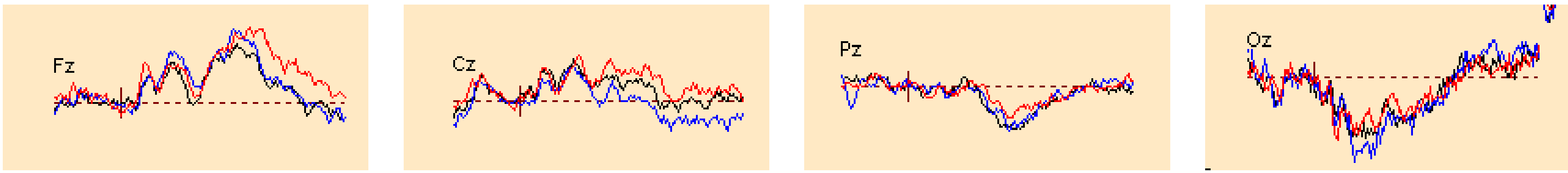
Neutral



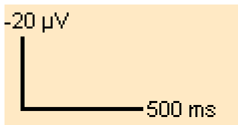
Participant	Electrode site
5	
6	
7	
8	

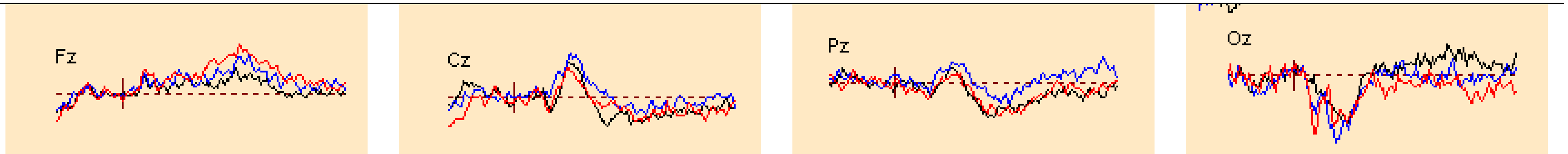
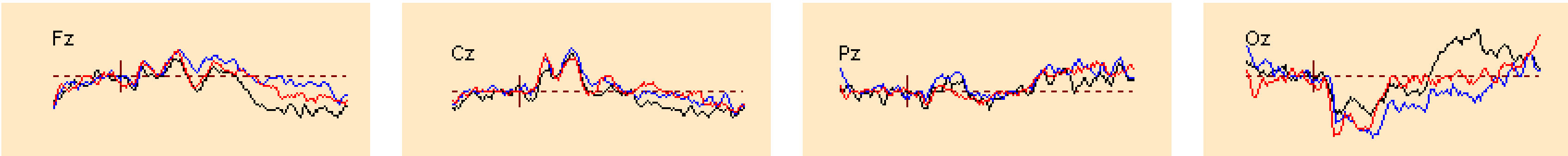
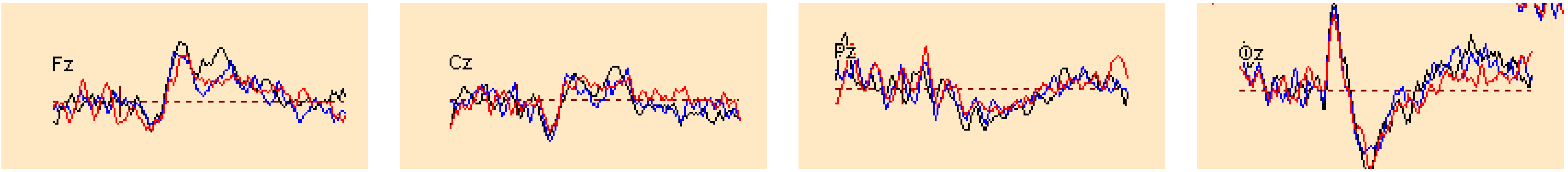
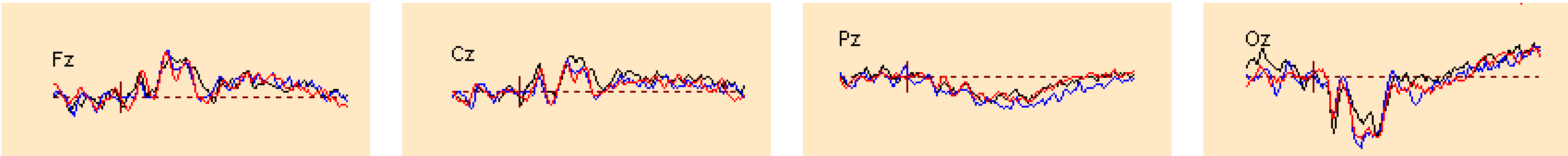
Picture stimuli:
Positive
Negative
Neutral



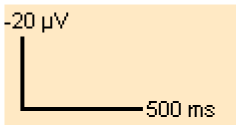
Participant	Electrode site
9	
10	
11	
12	

Picture stimuli:
Positive
Negative
Neutral



Participant	Electrode site
13	
14	
15	
16	

Picture stimuli:
Positive
Negative
Neutral



Appendix Q

Study 3 findings: Carver and White BIS/ BAS Scales

Behavioural data

There were no significant correlations between Carver and White's BIS/BAS Scales and the image stimuli (see Table Q.1).

Table Q.1

Bivariate Correlations between the RST Traits and Relative Mean RT Valence Scores

	Negative images	Positive images	Neutral images
BAS scales			
CW BAS: Reward Responsiveness	-.399	-.219	-.216
CW BAS: Drive	-.089	-.021	.034
CW BAS: Fun Seeking	-.313	-.047	-.104
FFFS scales			
CW FFFS: Fear	-.289	-.338	-.298

Note. CW = Carver and White BIS/ BAS Scales.

Psychophysiological data

N100 and N200 (Cz and Fz electrodes). There was a significant main effect of CW BAS: Fun Seeking, revealing that higher BAS scores were associated with greater N100 mean amplitudes at the Cz electrode site (see Table Q.2). While the main effect of CW BAS Reward Responsiveness was approaching significance (see Table Q.2), there were no additional main effects of BAS/FFFS or trait x valence interactions on image processing (as assessed via the N100 and N200) at the Fz and Cz electrode sites.

P300 (Pz and Oz electrodes). There were no significant main effects of BAS/FFFS or trait x valence interactions on image processing (as assessed via the P300) at the Pz and Oz electrode sites. While the focus of Study 3 was on the BAS and the FFFS traits, the findings did reveal a significant CW BIS x valence interaction. However, despite this significant interaction, there were no significant partial correlations between CW BIS and negative images, r = .436, p = .104, CW BIS and positive images, r = .207, p = .461, nor between CW BIS and neutral images, r = .167, p = .551. Despite these correlations failing to reach significance, the direction of the trend relationship is strongest between the BIS and negative images, with the size of observed effect medium and weaker associations observed between the BIS and positive/ neutral images, as would be expected.

CW FFFS: Fear x valence interaction approached significance, with a large effect size. Although, there were no significant partial correlations between CW FFFS: Fear and negative images, *r* = .138, *p* = .621, nor between CW FFFS: Fear and positive images, *r* = .214, *p* = .443, nor between CW FFFS: Fear and neutral images, *r* = .173, *p* = .539. The interaction between CC FFFS and valence also approached significance, with a large effect size

TableQ.2

Significant and Trend ANOVA Effects of RST Traits and Valence on Picture Processing (ERP Response)

Effect	F	p	η^2
<u>Cz N100</u>			
CW BAS: Fun Seeking and valence on processing (n = 16)			
Fun Seeking	6.57	.023	.32
Valence	0.45	.645	.03
Fun Seeking x valence	0.46	.635	.03
<u>Cz N100</u>			
CW BAS: Reward Responsiveness and valence on processing (n = 16)			
Reward Responsiveness	3.57	.080	.20
Valence	0.15	.863	.01
Reward Responsiveness x valence	0.31	.733	.02
<u>Oz P300</u>			
CW FFFS: Fear and valence on processing (n = 15)			
FFFS: Fear	0.15	.707	.01
Valence	3.22	.056	.17
FFFS: Fear x valence	3.27	.054	.17
CW BIS and valence on processing (n = 15)			
BIS	0.04	.847	.00
Valence	4.05	.029	.19
BIS x valence	4.24	.025	.20

Note. CW = Carver and White’s BIS/ BAS Scales

Appendix R

Non-Significant ANOVA Effects: RST x Valence Effects on ERP Components

Table R.1

Non-Significant Effects of BAS and Valence at Fz location on Pre-attentional Processes (N100 response) (n = 16)

Effect	F	p	η_p^2
CW BAS: Reward Responsiveness and valence on processing			
Reward Responsiveness	1.16	.300	.076
valence	2.01	.153	.125
Reward Responsiveness x valence	1.58	.224	.101
CW BAS: Drive and valence on processing			
Drive	0.26	.622	.018
valence	2.07	.145	.129
Drive x valence	1.01	.378	.067
CW BAS: Fun Seeking and valence on processing			
Fun Seeking	1.92	.187	.121
valence	0.87	.431	.058
Fun Seeking x valence	0.66	.523	.045
CC BAS: Reward Interest and valence on processing			
Reward Interest	2.26	.155	.139
valence	0.71	.502	.048
Reward Interest x valence	0.26	.775	.018
CC BAS: Goal-Drive Persistence and valence on processing			
Goal-Drive Persistence	0.04	.847	.003
valence	2.36	.113	.114
Goal-Drive Persistence x valence	1.33	.282	.086
CC BAS: Impulsivity and valence on processing			
Impulsivity	1.88	.192	.118
valence	0.05	.951	.004
Impulsivity x valence	0.06	.947	.004
CC Defensive Fight and valence on processing			
Defensive Fight	0.46	.516	.031
valence	1.22	.311	.080
Defensive Fight x valence	0.51	.607	.035

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table R.2

Non-Significant Effects of FFFS and Valence at Fz location on Pre-attentional Processes (N100 response) (n = 16)

Effect		*F*	*p*	η_p^2
CW FFFS: Fear and valence on processing				
	FFFS: Fear	0.02	.892	.001
	valence	1.56	.228	.100
	FFFS: Fear x valence	0.91	.413	.061
CC FFFS and valence on processing				
	FFFS	0.02	.892	.001
	valence	0.43	.652	.030
	FFFS x valence	0.04	.963	.003
CC Panic and valence on processing				
	Panic	0.34	.572	.023
	valence	1.00	.381	.067
	Panic x valence	0.47	.629	.033
Jackson's FFFS and valence on processing				
	FFFS	0.12	.737	.008
	valence	0.62	.545	.042
	FFFS x valence	0.24	.787	.017
Jackson's Flight and valence on processing				
	Flight	1.36	.262	.089
	valence	0.79	.464	.053
	Flight x valence	0.13	.883	.009
Jackson's Freezing and valence on processing				
	Freezing	1.26	.281	.082
	valence	0.02	.981	.001
	Freezing x valence	0.09	.910	.007

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.3

Non-Significant Effects of BIS and Valence at Fz location on Pre-attentional Processes (N100 response)

Effect	F	p	η_p^2
CW BIS and valence on processing (n = 16)			
BIS	0.02	.899	.001
valence	0.35	.708	.024
BIS x valence	0.13	.877	.009
CW BIS: Anxiety and valence on processing (n = 15)			
BIS: Anxiety	1.20	.294	.084
valence	0.40	.677	.030
BIS: Anxiety x valence	0.60	.559	.044
CC BIS and valence on processing (n = 16)			
BIS	0.23	.638	.016
valence	0.45	.643	.031
BIS x valence	0.37	.692	.026
Jackson's BIS and valence on processing (n = 16)			
BIS	0.89	.361	.060
valence	2.83	.074	.168
BIS x valence	1.96	.160	.123

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.4

Non-Significant Effects of BAS and Valence at Cz location on Pre-attentional Processes (N100 response) (n = 16)

Effect	*F*	*p*	η_p^2
CW BAS: Drive and valence on processing			
Drive	0.08	.786	.005
valence	0.41	.665	.029
Drive x valence	0.38	.688	.026
CC BAS: Goal-Drive Persistence and valence on processing			
Goal-Drive Persistence	0.09	.764	.007
valence	0.02	.982	.001
Goal-Drive Persistence x valence	0.09	.917	.006
CC BAS: Impulsivity and valence on processing			
Impulsivity	1.40	.256	.091
valence	0.13	.877	.009
Impulsivity x valence	0.32	.727	.022
CC Defensive Fight and valence on processing			
Defensive Fight	0.46	.508	.032
valence	1.05	.362	.070
Defensive Fight x valence	1.15	.332	.076

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.5

Non-Significant Effects of FFFS and Valence at Cz location on Pre-attentional Processes (N100 response) (n = 16)

Effect		F	p	η_p^2
CW FFFS: Fear and valence on processing				
	FFFS: Fear	0.71	.414	.048
	valence	0.72	.494	.049
	FFFS: Fear x valence	0.48	.621	.033
CC FFFS and valence on processing				
	FFFS	0.94	.350	.063
	valence	1.33	.280	.087
	FFFS x valence	1.17	.324	.077
CC Panic and valence on processing				
	Panic	0.65	.435	.044
	valence	0.92	.409	.062
	Panic x valence	1.07	.357	.071
Jackson’s FFFS and valence on processing				
	FFFS	0.50	.489	.035
	valence	1.23	.309	.080
	FFFS x valence	1.24	.305	.081
Jackson’s Flight and valence on processing				
	Flight	1.48	.244	.096
	valence	0.79	.464	.053
	Flight x valence	0.55	.584	.038
Jackson’s Freezing and valence on processing				
	Freezing	0.17	.689	.012
	valence	1.27	.296	.083
	Freezing x valence	1.30	.289	.085

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table R.6

Non-Significant Effects of BIS and Valence at Cz location on Pre-attentional Processes (N100 response)

Effect	F	p	η_p^2
CW BIS and valence on processing (n = 16)			
BIS	0.57	.463	.039
valence	1.47	.248	.095
BIS x valence	1.25	.302	.082
CW BIS: Anxiety and valence on processing (n = 15)			
BIS: Anxiety	0.23	.641	.017
valence	1.50	.243	.103
BIS: Anxiety x valence	1.34	.279	.093
CC BIS and valence on processing (n = 16)			
BIS	0.72	.410	.049
valence	2.07	.146	.129
BIS x valence	1.91	.168	.120
Jackson's BIS and valence on processing (n = 16)			
BIS	0.62	.443	.043
valence	0.38	.686	.027
BIS x valence	0.16	.854	.011

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.7

Non-Significant Effects of BAS and Valence at Fz location on Pre-attentional Processes (N200 response) (n = 15)

Effect		F	p	η_p^2
CW BAS: Reward Responsiveness and valence on processing				
	Reward Responsiveness	0.05	.827	.004
	valence	1.71	.201	.116
	Reward Responsiveness x valence	2.07	.146	.137
CW BAS: Drive and valence on processing				
	Drive	2.88	.114	.181
	valence	1.29	.292	.090
	Drive x valence	0.73	.494	.053
CW BAS: Fun Seeking and valence on processing				
	Fun Seeking	1.41	.256	.098
	valence	0.22	.805	.017
	Fun Seeking x valence	0.60	.554	.044
CC BAS: Reward Interest and valence on processing				
	Reward Interest	1.23	.288	.086
	valence	0.68	.515	.050
	Reward Interest x valence	1.04	.367	.074
CC BAS: Goal-Drive Persistence and valence on processing				
	Goal-Drive Persistence	1.93	.189	.129
	valence	1.66	.209	.113
	Goal-Drive Persistence x valence	1.37	.273	.095
CC BAS: Reward Reactivity and valence on processing				
	Reward Reactivity	0.31	.589	.023
	valence	0.52	.600	.039
	Reward Reactivity x valence	0.91	.416	.065
CC Defensive Fight and valence on processing				
	Defensive Fight	1.71	.214	.116
	valence	0.37	.695	.028
	Defensive Fight x valence	0.39	.681	.029
Jackson's BAS and valence on processing				
	BAS	0.88	.367	.063
	valence	0.40	.677	.030
	BAS x valence	0.58	.565	.043

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.8

Non-Significant Effects of FFFS and Valence at Fz location on Pre-attentional Processes (N200 response) (n = 15)

Effect		F	p	η_p^2
CW FFFS: Fear and valence on processing				
	FFFS: Fear	0.90	.359	.065
	valence	0.63	.542	.046
	FFFS: Fear x valence	0.30	.741	.023
CC FFFS and valence on processing				
	FFFS	0.05	.834	.004
	valence	0.48	.624	.036
	FFFS x valence	0.19	.828	.014
CC Panic and valence on processing				
	Panic	1.05	.323	.075
	valence	0.13	.883	.010
	Panic x valence	0.44	.652	.032
Jackson’s FFFS and valence on processing				
	FFFS	0.02	.886	.002
	valence	0.43	.653	.032
	FFFS x valence	0.19	.829	.014
Jackson’s Flight and valence on processing				
	Flight	1.87	.195	.125
	valence	2.17	.135	.143
	Flight x valence	1.15	.334	.081
Jackson’s Freezing and valence on processing				
	Freezing	0.94	.351	.067
	valence	0.16	.853	.012
	Freezing x valence	0.55	.585	.040

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table R.9

Non-Significant Effects of BIS and Valence at Fz location on Pre-attentional Processes (N200 response)

Effect	*F*	*p*	η_p^2
CW BIS and valence on processing (*n* = 15)			
BIS	0.63	.443	.046
valence	0.10	.904	.008
BIS x valence	0.01	.988	.001
BIS: Anxiety and valence on processing (*n* = 14)			
BIS: Anxiety	0.72	.413	.056
valence	1.18	.323	.090
BIS: Anxiety x valence	1.48	.247	.110
CC BIS and valence on processing (*n* = 15)			
BIS	2.22	.160	.146
valence	0.03	.967	.003
BIS x valence	0.21	.813	.016
Jackson’s BIS and valence on processing (*n* = 15)			
BIS	1.21	.291	.085
valence	0.31	.879	.010
BIS x valence	0.30	.742	.023

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table R.10

Non-Significant Effects of BAS and Valence at Cz location on Pre-attentional Processes (N200 response) (n = 15)

Effect		F	p	η_p^2
CW BAS: Reward Responsiveness and valence on processing				
	Reward Responsiveness	0.29	.601	.020
	valence	1.08	.354	.071
	Reward Responsiveness x valence	1.09	.352	.072
CW BAS: Drive and valence on processing				
	Drive	1.03	.328	.068
	valence	0.60	.556	.041
	Drive x valence	0.64	.535	.044
CW BAS: Fun Seeking and valence on processing				
	Fun Seeking	2.52	.135	.153
	valence	0.05	.953	.003
	Fun Seeking x valence	0.07	.934	.005
CC BAS: Reward Interest and valence on processing				
	Reward Interest	1.41	.255	.092
	valence	0.68	.514	.046
	Reward Interest x valence	0.75	.481	.051
CC BAS: Goal-Drive Persistence and valence on processing				
	Goal-Drive Persistence	0.96	.343	.064
	valence	0.75	.481	.051
	Goal-Drive Persistence x valence	0.50	.613	.034
CC Defensive Fight and valence on processing				
	Defensive Fight	0.64	.437	.044
	valence	0.06	.939	.004
	Defensive Fight x valence	0.14	.868	.010
Jackson's BAS and valence on processing				
	BAS	0.93	.351	.062
	valence	0.18	.836	.013
	BAS x valence	0.11	.895	.008

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.11

Non-Significant Effects of FFFS and Valence at Cz location on Pre-attentional Processes (N200 response) (n = 15)

Effect	*F*	*p*	η_p^2
CW FFFS: Fear and valence on processing			
FFFS: Fear	0.19	.672	.013
valence	0.05	.951	.004
FFFS: Fear x valence	0.05	.950	.004
CC FFFS and valence on processing			
FFFS	< 0.01	.975	< .001
valence	1.71	.200	.109
FFFS x valence	1.91	.166	.120
CC Panic and valence on processing			
Panic	0.27	.609	.019
valence	0.85	.436	.057
Panic x valence	1.23	.309	.080
Jackson's FFFS and valence on processing			
FFFS	0.01	.928	.001
valence	1.85	.176	.117
FFFS x valence	1.53	.233	.099
Jackson's Flight and valence on processing			
Flight	1.55	.234	.099
valence	2.47	.103	.150
Flight x valence	1.76	.191	.112
Jackson's Freezing and valence on processing			
Freezing	0.27	.609	.019
valence	0.46	.638	.032
Freezing x valence	0.60	.557	.041

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.12

Non-Significant Effects of BIS and Valence at Cz location on Pre-attentional Processes (N200 response)

Effect	*F*	*p*	η_p^2
CW BIS and valence on processing (*n* = 15)			
BIS	0.21	.653	.015
valence	0.17	.844	.012
BIS x valence	0.15	.866	.010
CW BIS: Anxiety and valence on processing (*n* = 14)			
BIS: Anxiety	1.87	.194	.126
valence	0.03	.973	.002
BIS: Anxiety x valence	0.01	.994	< .001
CC BIS and valence on processing (*n* = 15)			
BIS	0.26	.621	.018
valence	0.48	.626	.033
BIS x valence	0.54	.591	.037
Jackson's BIS and valence on processing (*n* = 15)			
BIS	0.05	.833	.003
valence	0.71	.499	.049
BIS x valence	0.51	.607	.035

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.13

Non-Significant Effects of BAS and Valence at Pz location on Picture Processing (P300 response) (n = 15)

Effect	*F*	*p*	η_p^2
CW BAS: Reward Responsiveness and valence on processing			
Reward Responsiveness	1.73	.212	.117
valence	0.79	.463	.058
Reward Responsiveness x valence	0.74	.488	.054
CW BAS: Drive and valence on processing			
Drive	< 0.01	.961	< .001
valence	0.13	.380	.010
Drive x valence	0.08	.926	.006
CW BAS: Fun Seeking and valence on processing			
Fun Seeking	< 0.01	.949	< .001
valence	0.70	.505	.051
Fun Seeking x valence	0.71	.500	.052
CC BAS: Reward Interest and valence on processing			
Reward Interest	< 0.01	.988	< .001
valence	1.55	.231	.107
Reward Interest x valence	1.43	.257	.099
CC BAS: Goal-Drive Persistence and valence on processing			
Goal-Drive Persistence	0.02	.900	.001
valence	0.13	.880	.010
Goal-Drive Persistence x valence	0.09	.918	.007
CC BAS: Reward Reactivity and valence on processing			
Reward Reactivity	0.67	.429	.049
valence	1.91	.169	.128
Reward Reactivity x valence	1.76	.192	.119
CC BAS: Impulsivity and valence on processing			
Impulsivity	0.29	.599	.022
valence	1.51	.241	.104
Impulsivity x valence	1.37	.272	.095
CC Defensive Fight and valence on processing			
Defensive Fight	1.24	.286	.087
valence	0.77	.474	.056
Defensive Fight x valence	0.67	.518	.049

Effect	F	p	η_p^2
Jackson's BAS and valence on processing			
BAS	< 0.01	.985	< .001
valence	0.55	.582	.041
BAS x valence	0.53	.594	.039

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.14

Non-Significant Effects of FFFS and Valence at Pz location on Picture Processing (P300 response) (n = 15)

Effect	F	p	η_p^2
CW FFFS: Fear and valence on processing			
FFFS: Fear	0.19	.670	.014
valence	0.69	.512	.050
FFFS: Fear x valence	0.73	.494	.053
CC FFFS and valence on processing			
FFFS	0.38	.549	.028
valence	0.72	.497	.052
FFFS x valence	0.64	.538	.047
CC Panic and valence on processing			
Panic	0.57	.462	.042
valence	0.98	.390	.070
Panic x valence	0.86	.436	.062
Jackson's FFFS and valence on processing			
FFFS	0.66	.432	.048
valence	0.66	.523	.049
FFFS x valence	0.64	.534	.047
Jackson's Flight and valence on processing			
Flight	0.56	.466	.042
valence	0.38	.687	.028
Flight x valence	0.45	.644	.033
Jackson's Freezing and valence on processing			
Freezing	0.56	.470	.041
valence	1.12	.341	.079
Freezing x valence	1.02	.375	.073

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.15

Non-Significant Effects of BIS and Valence at Pz location on Picture Processing (P300 response)

Effect	*F*	*p*	η_p^2
CW BIS and valence on processing (*n* = 15)			
BIS	0.15	.702	.012
valence	0.65	.531	.048
BIS x valence	0.65	.528	.048
CW BIS: Anxiety and valence on processing (*n* = 14)			
BIS: Anxiety	2.33	.153	.162
valence	0.20	.817	.017
BIS: Anxiety x valence	0.20	.821	.016
CC BIS and valence on processing (*n* = 15)			
BIS	0.22	.650	.016
valence	1.19	.319	.084
BIS x valence	1.10	.349	.078
Jackson’s BIS and valence on processing (*n* = 15)			
BIS	1.67	.218	.114
valence	0.57	.571	.042
BIS x valence	0.68	.514	.050

Note. CW = Carver and White’s BIS/ BAS Scales; CC = Corr and Cooper’s RST-PQ

Table R.16

Non-Significant Effects of BAS and Valence at Oz location on Picture Processing (P300 response) (n = 15)

Effect	F	p	η_p^2
CW BAS: Reward Responsiveness and valence on processing			
Reward Responsiveness	0.44	.517	.033
valence	0.18	.840	.013
Reward Responsiveness x valence	0.04	.965	.003
CW BAS: Drive and valence on processing			
Drive	3.09	.103	.192
valence	1.32	.289	.092
Drive x valence	0.76	.476	.056
CW BAS: Fun Seeking and valence on processing			
Fun Seeking	0.43	.526	.032
valence	1.75	.193	.119
Fun Seeking x valence	1.59	.224	.109
CC BAS: Reward Interest and valence on processing			
Reward Interest	0.97	.343	.069
valence	1.62	.218	.111
Reward Interest x valence	1.67	.207	.114
CC BAS: Goal-Drive Persistence and valence on processing			
Goal-Drive Persistence	0.04	.841	.003
valence	0.83	.446	.060
Goal-Drive Persistence x valence	0.74	.487	.054
CC BAS: Reward Reactivity and valence on processing			
Reward Reactivity	1.10	.313	.078
valence	1.68	.206	.114
Reward Reactivity x valence	1.07	.356	.076
CC BAS: Impulsivity and valence on processing			
Impulsivity	0.16	.692	.012
valence	0.17	.848	.013
Impulsivity x valence	0.31	.735	.023
CC Defensive Fight and valence on processing			
Defensive Fight	0.22	.650	.016
valence	1.29	.293	.090
Defensive Fight x valence	1.11	.345	.079

Effect	F	p	η_p^2
Jackson's BAS and valence on processing			
BAS	0.83	.378	.060
valence	0.53	.593	.039
BAS x valence	0.43	.653	.032

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Table R.17

Non-Significant Effects of FFFS and Valence at Oz location on Picture Processing (P300 response) (n = 15)

Effect	*F*	*p*	η_p^2
CC Panic and valence on processing			
Panic	0.18	.680	.013
valence	0.71	.502	.052
Panic x valence	0.67	.522	.049
Jackson's FFFS and valence on processing			
FFFS	1.74	.210	.118
valence	2.12	.141	.140
FFFS x valence	1.44	.254	.100
Jackson's Flight and valence on processing			
Flight	0.26	.618	.020
valence	3.39	.049	.207
Flight x valence	1.94	.164	.130
Jackson's Freezing and valence on processing			
Freezing	0.14	.712	.011
valence	0.79	.466	.057
Freezing x valence	0.52	.601	.038

Note. CC = Corr and Cooper's RST-PQ

Table R.18

Non-Significant Effects of BIS and Valence at Oz location on Picture Processing (P300 response)

Effect	F	p	η_p^2
CW BIS: Anxiety and valence on processing (n = 15)			
BIS: Anxiety	1.67	.220	.122
valence	1.06	.364	.081
BIS: Anxiety x valence	1.43	.258	.107
CC BIS and valence on processing (n = 14)			
BIS	1.04	.326	.074
valence	0.57	.571	.042
BIS x valence	0.76	.479	.055
Jackson's BIS and valence on processing (n = 15)			
BIS	0.06	.804	.005
valence	1.54	.233	.106
BIS x valence	1.58	.224	.109

Note. CW = Carver and White's BIS/ BAS Scales; CC = Corr and Cooper's RST-PQ

Appendix S

Participant Consent Form: Study 3b

Queensland University of Technology Brisbane Australia

PARTICIPANT INFORMATION FOR QUT RESEARCH PROJECT

Personality and processing road safety messages

QUT Ethics Approval Number 1100001188

RESEARCH TEAM CONTACTS

Principal Researcher: Sherrie Kaye PhD Student
Associate Researchers: Dr Melanie White Supervisor
School of Psychology and Counselling, Queensland University of Technology (QUT)
Dr Ioni Lewis Supervisor
Centre for Accident Research and Road Safety – Queensland (CARRS-Q), QUT

DESCRIPTION

This project is being undertaken as part of a PhD project for Sherrie Kaye.

The purpose of this project is to gain a greater understanding of the relationship between personality and health related information processing. Specifically, this study is exploring how personality impacts on processing information about health related behaviours. This study is part of a larger planned program of research.

PARTICIPATION

The research team is looking for right-handed participants aged between 17 and 25 years old who hold a valid Australian drivers' licence (provisional or open drivers' licence). Participants will also be required to speak English as their first language and are required to have normal/ corrected to normal vision. However, exclusion criteria will apply if you have: 1) past or present history of psychiatric or neurological disorders; 2) use of regular medication (e.g., antiepileptic medication or antidepressants); 3) illicit drug use.

Your participation will involve completing a self-report questionnaire and a computerised cognitive task. The questionnaire asks you the extent to which you agree with statements about how you typically feel, for example, "If I see a chance to get something that I want, I move on it right away", and some background information. The computer task asks you to make a series of timed judgements towards picture stimuli by pressing one of two buttons. Brain wave activity (EEG) will be assessed throughout the session.

The EEG cap involves small detector electrodes placed on the scalp over a drop of non-irritant gel. The study will be conducted individually on the Kelvin Grove campus at QUT and is expected to take approximately 2 hours to complete. To recognise your contribution should you choose to participate, first year psychology students will be offered course credit for their time. Course credit for first year psychology students will be provided on completion of taking part in the study. All other participants will receive a $20Coles/Myer gift card as a small token of our appreciation.

Your participation in this project is voluntary. If you do agree to participate, you can withdraw from participation during the project without comment or penalty. Your decision to participate will in no way impact upon your current or future relationship with QUT (for example your grades). Please note, once you have completed the testing session it will not be possible to withdraw from this study as the questionnaire and other data you provide are anonymous and non-identifiable.

EXPECTED BENEFITS

It is expected that this project will not directly benefit you. However, it may improve our understanding of how individual differences in personality influence health related information processing.

RISKS

There are minimal risks associated with your participation in this project. These include:

- The EEG cap carries minimal risk and is not expected to cause any problems beyond slight irritation. Should you experience such discomfort you may ask the researcher to remove the EEG cap at any time throughout the study without negative consequences.
- To link responses from the self-report questionnaires and computerised task a non-identifier code will be used to ensure data will remain anonymous.
- As part of the computerised task, you will be required to view a series of pictures which have previously been shown in road safety commercials. If you have any concerns about being exposed to such pictures, it is encouraged that you do not take part in this study.

QUT provides for limited free counselling for research participants of QUT projects who may experience discomfort or distress as a result of their participation in the research. Should you wish to access this service please contact the Clinic Receptionist of the QUT Psychology Clinic on 3138 0999. Please indicate to the receptionist that you are a research participant.

CONFIDENTIALITY

All comments and responses are anonymous and will be treated confidentially. The names of individual persons are not required in any of the responses. In matching the responses from the computerised task and the questionnaires an identifier code link will be used, however this is unable to be used to personally identify individual participants. The researchers will ask you to provide an email address that will be used to contact you with the follow-up questionnaire link. The email address will only be used for the purpose of this study and will be kept separate from the questionnaire responses and responses from the computerised task to ensure confidentially. Once the study has been completed, the email address will be destroyed.

CONSENT TO PARTICIPATE

Once you understand what the project is about, and if you agree to participate, we ask that you sign the Consent From (enclosed) to confirm your agreement to participate.

QUESTIONS / FURTHER INFORMATION ABOUT THE PROJECT

If have any questions or require any further information about the project please contact one of the research team members below.

Sherrie Kaye	Dr Melanie White	Dr Ioni Lewis
3138 0045	3138 4714	3138 4966
s1.kaye@qut.edu.au	melanie.white@qut.edu.au	i.lewis@qut.edu.au

CONCERNS / COMPLAINTS REGARDING THE CONDUCT OF THE PROJECT

QUT is committed to research integrity and the ethical conduct of research projects. However, if you do have any concerns or complaints about the ethical conduct of the project you may contact the QUT Research Ethics Unit on 3138 5123 or email ethicscontact@qut.edu.au. The QUT Research Ethics Unit is not connected with the research project and can facilitate a resolution to your concern in an impartial manner.

Thank you for helping with this research project. Please keep this sheet for your information.